ILLINOIS HISTORY SURVEY

# Reports

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INSIDE





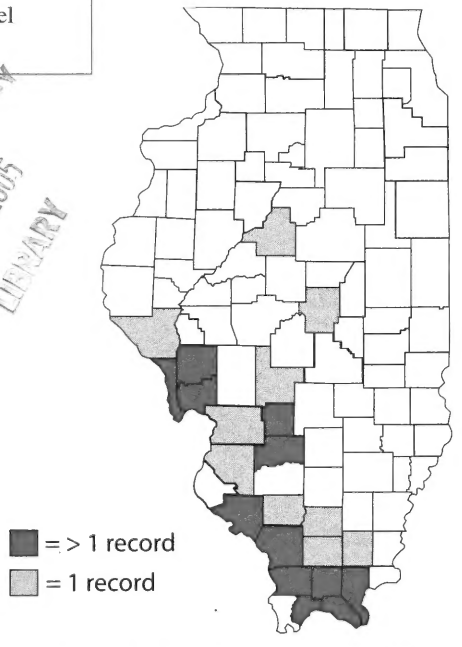
# Was That an Armadillo I Just Saw?

Illinois has a new animal immigrant—the nine-banded armadillo (*Dasypus novemcinctus*). This quirky, armor-plated mammal actually is native to the New World tropics. It first was documented in the U.S. in the Rio Grande Valley of southern Texas in 1849. At the beginning of the twentieth century the armadillo was restricted to Texas, but it has been steadily moving northward and eastward. Escaped animals established a population in Florida that also has spread. Natural dispersal has been augmented by people intentionally and inadvertently transporting armadillos to new places. Overall, the species has expanded its range 4–10 km/year, which is considered rapid for mammals.

The nine-banded armadillo (*Dasypus novemcinctus*), a recent Illinois immigrant. **Photo by Michael Jeffords, INHS Office of the Chief**

By 1954 the armadillo's range included southern Oklahoma, all of Louisiana, and southern Arkansas. In 1972 the armadillo also occupied parts of Mississippi, Alabama, and Georgia and there were outlying records in Colorado, Kansas, Missouri, and Tennessee. By 1995 it was established in most of Oklahoma, southern Kansas, Arkansas, southern Missouri, western Tennessee, Mississippi, much of Alabama and Georgia, and southern South Carolina, and individuals occurred as far north as Nebraska. The species' northward expansion will be limited by the severity of winter weather since armadillos can't hibernate. Its predicted range covers areas with mean January temperatures greater than -2°C and includes southern Illinois to about 39°N latitude (running across the state just north of Alton and south of Effingham).

There had been sporadic occurrences of armadillos in Illinois since the 1970s, but a flurry of recent sightings prompted us to begin a survey (supported by the Illinois Wildlife Preservation Fund) in 2003. We mailed a questionnaire to 135 individuals knowledgeable about southern Illinois' fauna, including Illinois Department of Natural Resources (IDNR) district heritage biologists, wildlife biologists, and foresters; conservation police officers; Nature Preserves Commission field staff; and state park superintendents. Surveys were also addressed to the person or agency responsible for animal control in 22 southern Illinois




Armadillo sitings records, 1999–2003.

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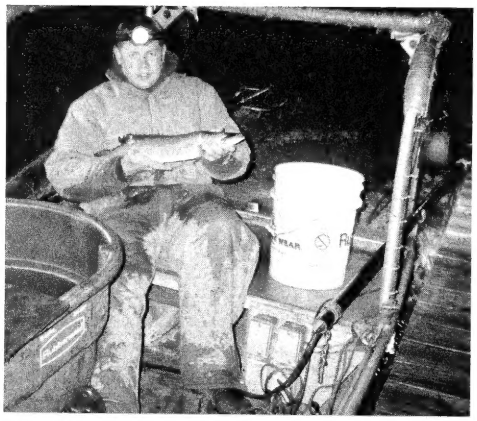
# Evaluation of Growth, Survival, and Thermal Selection Differences among Genetic Stocks of Muskellunge

Muskellunge was first documented in 1824 by Samuel Latham Mitchell and given the name *Esox masquinongy*. During the late 1800s and early 1900s, apparent correlations between color/pattern and location led to the establishment of three separate species for a short time. As interpretation of the color and marking distinctions progressed, the idea of subspecies was introduced. By the late 1970s the idea that all variations were indeed one single species, without enough evidence to warrant subspecies classifications, had been established. More recent genetic analysis of various populations revealed three related clusters. The clusters were found to be related to major river drainage origins, suggesting the existence of divergent stocks. Existing information indicates muskellunge persisted through the Wisconsin glacier period in the Mississippi refugium and upon glacial recession, moved north up the Mississippi valley and established its current range via the Mississippi and Ohio River systems. As muskellunge were isolated by major river drainages, they experienced different environmental conditions and thermal histories. As these isolated groups diverged through recolonization, genetic processes, such as natural selection, resulted in stocks of muskellunge that are genetically dissimilar, and likely physiologically and behaviorally different from one another. The currently identified genetically distinct muskellunge stocks are referred to as the Upper Mississippi River drainage stock, the Great Lakes drainage stock, and the Ohio River drainage stock.

We initiated a research project aimed at identifying differences in growth, survival, and other performance characteristics among populations and stocks of muskellunge. Previous work conducted by Illinois Natural History Survey (INHS) scientists compared physiological differences among young-of-year (YOY) muskellunge from various stocks in the laboratory. Additional research is needed to identify and understand potential differences in physiological and behavioral characteristics of muskellunge stocks across all age classes in natural systems. In this study we compare growth, survival, and thermal selection of different populations and stocks of muskellunge across a range of latitudes in Illinois. In Illinois waters, as well as many other midwestern waters, natural muskellunge populations are either not found or have been extirpated. Stocking has become the primary management tool for establishing and maintaining muskellunge populations. The high costs associated with producing these fish create the need for efficient management practices. Previous research efforts have determined the size of fish and timing of stocking to maximize growth and survival to desired size ranges. Comparatively little effort has focused on the appropriate genetic lineage of brood stock to be used when stocking for sportfish management. This research examines growth and survival differences among stocks in lower Midwest climates and will have management implications for using appropriate brood stocks in various thermal regimes.



Researcher Curt Wagner with muskellunge.
**Photo by staff of INHS Kaskaskia Biological Station**

Two predominant models of how different fish stocks might grow and survive at various latitudes exist in the literature. The first model, thermal adaptation, is the concept that genetic variation in physiological rates represents local population adaptation to native environments. The theory predicts that physiological rates operate most efficiently at the temperatures most commonly experienced in the native environment. Based on the model of thermal adaptation, it is expected that muskellunge from higher latitudes would exhibit faster growth rates at lower temperatures than muskellunge from lower latitudes, and vice versa. An alternative model, the countergradient variation model, focuses on differences in length of the growing season across latitudes, with lower latitudes having longer growing seasons than higher latitudes. In this model, growth of both high- and low-latitude individuals occurs over the same range of temperatures, yet the growth rates at each temperature vary with latitude. Individuals from higher latitudes exhibit faster growth rates over all temperatures comprising the shorter growing season, resulting in similar sizes as individuals from lower latitudes at the end of the growing season. In common environment experiments, muskellunge from higher latitude populations would exhibit faster growth rates than muskellunge from lower latitudes.

**Reservoir and Pond Experiments**

To explore differences in growth, survival, and thermal selection, multiple populations and stocks of muskellunge are being used in reservoir and pond experiments. Muskellunge from the Upper Mississippi River drainage stock include the Leech Lake, Minnesota population and the Minocqua Chain, Wisconsin population. Muskellunge from the Ohio River drainage stock include the Lake Chautauqua, New York population, the Clear Fork Lake, Ohio population, and the Cave Run Lake, Kentucky population. The Illinois population is the progeny from North Spring Lake, Illinois, that was first established in the early 1980s and has subsequently been stocked yearly with muskellunge from throughout the native range of the species. The actual progeny of any particular year results in an unknown-origin population, or more likely, a mixed-origin population.

Three reservoirs throughout Illinois are stocked each fall with YOY muskellunge from various populations and stocks (Fig. 1). These reservoirs represent the latitudinal climatic variation that exists throughout Illinois. Young-of-year muskellunge from multiple sources are batch marked by stock and introduced into study waters each fall.

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# Muskellunge

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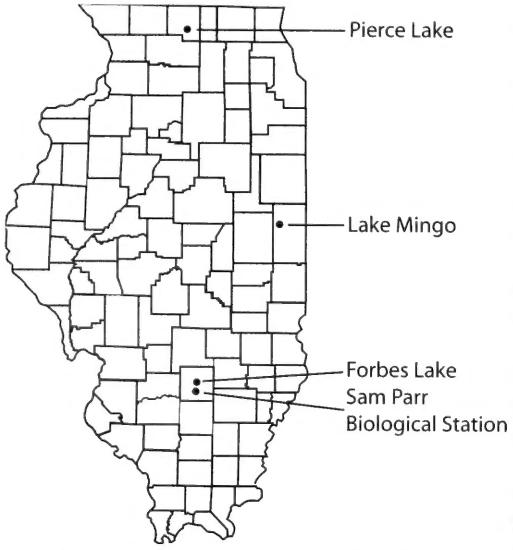



Figure 1. Illinois reservoirs stocked for evaluation of growth and survival among muskellunge stocks.

Growth and survival are determined in the spring and fall each year via nighttime electrofishing. Age-1 and older muskellunge receive a passive integrated transponder (PIT) tag upon recapture to enable identification of individual fish. Water temperatures are continuously recorded to relate thermal regime to observed differences in growth and survival.

Concurrent with the reservoir experiments, pond trials are being conducted to explore growth and survival differences among populations and stocks of muskellunge. The advantages of using experimental ponds include (1) a more controlled environment, (2) ability to replicate experiments, and (3) ability to monitor growth and survival of individual fish. Similar numbers of YOY muskellunge from each of three populations are introduced into each of three, 0.4-ha ponds at the INHS Sam Parr Biological Station (Fig. 1). Prior to stocking, all muskellunge are PIT tagged to enable identification at draining. Ponds are drained at six-month intervals to assess survival and growth differences among populations and stocks. Although it is too early in the study to draw definitive conclusions, an interesting initial result suggests that muskellunge from the Ohio River drainage stock have higher over-winter growth rates than muskellunge from the Upper Mississippi River drainage stock in the research ponds located in southern Illinois (Fig. 2).

**Radiotelemetry Experiment**

Radiotelemetry is being conducted in Forbes Lake in southern Illinois to identify thermal selection differences among stocks of muskellunge. Similar numbers of age-2 muskellunge from three populations were implanted with radio transmitters in March 2004 and released. Transmitters are temperature-sensing to determine occupied water temperature. Multiple 24-hour tracking events enable detection of diel, seasonal, and overall thermal selection differences among stocks of muskellunge. Additionally, differences in movement, home range sizes, and habitat usage will be examined.

Ten muskellunge (400–600 mm) each from the Upper Mississippi River drainage stock (Leech Lake, Minnesota population), Ohio River drainage stock (Cave Run Lake, Kentucky population), and the North Spring Lake, Illinois progeny are being tracked during the day about once per week with 24-hour diel tracking events conducted every three to five weeks. Information on home range sizes and overall thermal selection are obtained from both the day and the 24-hour tracking regimes, whereas information on movement rates, thermal selection across diel periods, and habitat use across diel periods come from the 24-hour sampling regime. Preliminary analyses of data from two diel tracking events conducted in May 2004 showed significant differences in thermal selection among populations of muskellunge. The Ohio River drainage stock selected significantly warmer temperatures than the Upper Mississippi River drainage stock with Illinois muskellunge intermediate. Gaining an understanding of thermal selection differences among stocks, and comparing these results with experimentally determined growth and survival differences, will allow assessment of the suitability of various stocks to different waters.

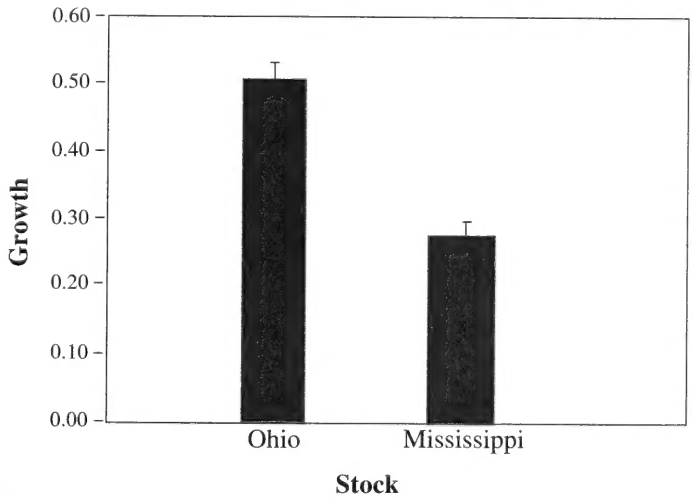



Figure 2. Mean daily growth rates (g/d) of the Ohio River drainage stock and the Upper Mississippi River drainage stock introduced into three, 0.4-ha ponds in October 2003 and drained during April 2004. Vertical lines represent 95% confidence limits.

**Acknowledgements**

This research was made possible with the support of numerous individuals and organizations. Muskellunge for the project have been donated from several sources including the Departments of Natural Resources of Minnesota, Wisconsin, and Ohio, as well as the New York State Department of Environmental Conservation, the Pennsylvania Fish and Boat Commission, and the Kentucky Department of Fish and Wildlife. The research is funded in part by the Illinois Department of Natural Resources, Division of Fisheries, through the Federal Aid in Sport Fish Restoration. Additional funding has come from the Illinois Conservation Foundation and from the Gander Mountain Habitat Award administered by Muskies Inc. Muskies Inc. has also been helpful in funding the telemetry portion of the study. The Central Illinois Muskie Hunters chapter of Muskies Inc. has contributed substantial time and monetary support. Additional funding and support have come from the Illinois Muskie Alliance, the Chicagoland Muskie Hunters, and the Shelbyville Muskie Club.

*Curtis P. Wagner, Matt J. Diana, and David H. Wahl, Center for Aquatic Ecology and Conservation*

# SPOIL: The Springs of Illinois

Springs serve as a unique interface between groundwater and surfacewater. The physical and chemical composition of spring water reflects not only the mineral composition of the various rock strata with which the water has been in contact, but also the various chemicals that percolate into groundwater. Along with their associated seeps and outflow brooks, springs provide a unique habitat for endemic species (organisms restricted to a localized area) because they provide a nearly constant physical and chemical environment. Until recently, little emphasis had been given to the springs of Illinois, particularly from the perspective of species richness and endemism in relation to water quality.

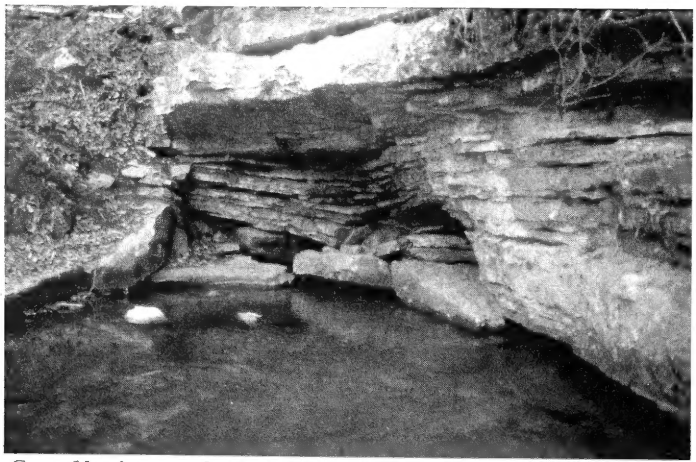
Most Illinois springs are located in the Mississippian, Devonian, and Pennsylvanian limestone and sandstone of the karst regions (Fig. 1) in southern, southwestern, western, and northwestern Illinois.

In 1991, a cooperative program between the Illinois Natural History Survey and the Illinois State Geological Survey was initiated to develop a database on the springs of Illinois (SPOIL). This study completed a broad investigation of 270 springs in Illinois. The physiographic and hydrogeologic features of 75 of these springs were determined, along with 51 water quality parameters (including analysis for the agricultural herbicides Atrazine, Alachlor, Metolachlor, and Cyanazine), their biotic diversity, and the plant community in and adjacent to these springs. In addition, bacterial samples were collected at 60 of these springs during 1996 and 1997 to determine the extent of groundwater contamination resulting from seepage of domestic septic systems and livestock operations. Wetzel and Webb have established a Web site for this Springs of Illinois project, http://www.inhs.uiuc.edu/~mjwetzel/SPOIL.hp.html, where citizens can read a summary of work completed to date, view a map of Illinois noting general locations of springs and their association with karst and sinkhole regions in the state, be directed to scientists working on this project, and find citations for publications resulting from this research.

Faunal, floral, bacterial, and water quality samples were collected from the springhead and the first 100 m of each springbrook. Illinois springs are predominately hard water limestone springs with a pH greater than 7.0 and alkalinity above 25 mg/L (as CaCO3) and are dominated by a noninsectan community (Turbellaria, Annelida, Amphipoda, Isopoda, Gastropoda). Significant differences in species richness are evident among springs and we are currently exploring multivariate approaches to analyzing physicochemical and biological data.

Taxa richness ranged from 3 to 73 species and was dominated by 4 species of flatworms; 29 species of aquatic worms; 11 species of amphipods, 5 of which are troglobites; 6 species of aquatic isopods including 3 troglobitic species, and 1 new species to science; and 7 taxa of ostracods, including 2 species new to science. Aquatic insects (133 taxa) comprised the most diverse group of aquatic macroinvertebrates, but in low abundance.

During this investigation two species of plants listed as State Threatened (*Carex laxiculmis*, a spreading sedge and *Acalypha deamii*, large-seeded Mercury) were associated with springs.



Camp Vandeventer Spring in Monroe County. **Photo by Mark Wetzel, INHS Center for Biodiversity**

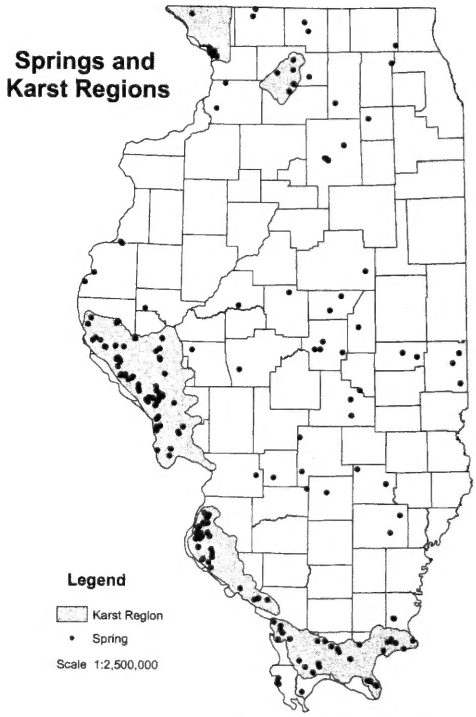



Figure 1. Locations of springs studied in SPOIL project. **Map created by C.P. Weibel, Illinois State Geological Survey**

Nitrate nitrogen, above a background level of 1.4 mg/L, was found to be a chronic problem particularly in southwestern Illinois where concentrations often exceeded the USEPA Maximum Contaminant Level of 10 mg/L. Nitrate nitrogen levels in the Shawnee Hills were found to be below background levels.

The agricultural herbicides Atrazine, Alachlor, and Cyanazine were detected in Illinois springs, particularly in southwestern Illinois where occasionally concentrations exceeded the USEPA guidelines. The herbicide Metolachlor, though occasionally detected, never exceeded the USEPA Health Advisory Levels.

Currently, we are in the final stage of preparation of a large manuscript that brings together all the pertinent information related to Illinois springs.

Urban and rural development, intensive agricultural practices, and a variety of other activities associated with land and water resources in the state have forced a measurable strain on unique groundwater ecosystems in these karst

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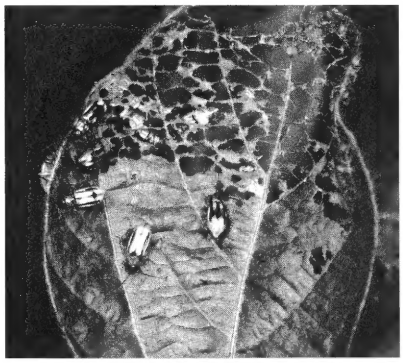
# Soybean Virus Transmission by Rootworms

Bean pod mottle virus is a beetle-transmitted disease of soybean. The disease causes a mottling of soybean leaves, and severe strains of the virus may cause puckering and distortion of the leaves in the upper canopy. Stems of infected plants may remain green after the pods have matured and plants may also retain the leaf petioles after the leaf blades have abscised, a condition sometimes referred to as "green stem." In addition to the green stems and petioles causing harvesting problems, bean pod mottle virus can lower seed quality and yield. When bean pod mottle virus occurs with soybean mosaic virus, severe symptoms may occur with yield losses exceeding 60%. Bean pod mottle virus was first reported in Illinois in 1975 and now occurs statewide. The primary vector of bean pod mottle virus is the bean leaf beetle, although other vectors include the southern corn rootworm, striped blister beetle, and grape colaspis. The bean leaf beetle transmits bean pod mottle virus efficiently for several days after it acquires the virus from infected plants, and these beetles are likely responsible for much of the localized spread of bean pod mottle virus. After emerging from hibernation in the spring, bean leaf beetles may feed on infected weedy legumes thereby acquiring the virus and transmitting it to healthy soybeans. The virus has been reported to be seed-transmitted in soybean at a frequency of only 0.1%. Further movement of the virus depends on beetle transmission.

Since the mid-1990s, western corn rootworm beetles have been found in very high numbers in soybean fields in east-central Illinois and northern Indiana. In addition to laying eggs in these fields (causing crop rotation to fail as a pest management practice), adults have also been observed feeding on soybean foliage. Although this feeding is usually not of economic concern, we discovered that some of the western corn rootworm beetles we collected in Illinois soybean fields in 1999 tested positive for bean pod mottle virus. We conducted laboratory and field experiments to determine if western corn rootworm adults could transmit the virus in soybeans (in addition to harboring it). The occurrence of the virus in beetles and plants was determined with ELISA (enzyme-linked immunosorbent assay). We also collected western corn rootworms from soybean fields in Illinois counties where these beetles were abundant and brought them back to the laboratory; the presence or absence of the virus in the beetles was also determined with ELISA.



Adult western corn rootworms feeding on soybean leaves at a soybean field in Urbana.

In laboratory cage studies, we demonstrated that western corn rootworm adults were able to transmit bean pod mottle virus to soybeans. This is the first report of bean pod mottle virus transmission by this insect. Fortunately, bean pod mottle virus transmission efficiency was 10 times lower for western corn rootworms than for bean leaf beetles. However, western corn rootworms have greater mobility than bean leaf beetles, which could lead to increased spread of bean pod mottle virus both within and between soybean fields. In mid-summer soybean field surveys, 20 of 21 Illinois counties had western corn rootworms that tested positive for bean pod mottle virus in 2000; in 2001, 20 of 23 Illinois counties had western corn rootworms that tested positive for bean pod mottle virus. The percentage of western corn rootworms testing positive for bean pod mottle virus ranged as high as 95% for beetles collected in soybean fields in some counties. Understanding the relationship between bean pod mottle virus and insect vectors, and the environmental factors which impact the abundance and distribution of these insects and the virus will improve management recommendations for this disease.

*Eli Levine and Joseph L. Spencer, Center for Ecological Entomology; Timothy R. Mabry and Scott A. Isard, University of Illinois*

# Springs

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areas. In particular, the rerouting and reduction of surface drainage and alteration of natural recharge patterns have affected our state's water resources by subjecting new areas to increased drainage, altering preexisting recharge areas, and reducing or eliminating discharge from springs.

The pending publication of the SPOIL manuscript will benefit the state of Illinois by providing a baseline resource on the location, current status, water quality, and biological diversity of Illinois springs. More importantly, it will serve as a background resource for land-use planning, groundwater resource management, and habitat protection for those agencies, organizations, and individuals interested in protecting the water quality, biological diversity, and hydrogeology of groundwater basins. This publication will also serve as a source book for the general public, educational institutions (primary and secondary schools, community colleges, universities), state (Illinois Department of Transportation, Illinois Department of Natural Resources, Illinois Environmental Protection Agency), and federal (U.S. Environmental Protection Agency, U.S. Department of Agriculture, U.S. Forest Service, U.S. Fish and Wildlife Service) agencies.

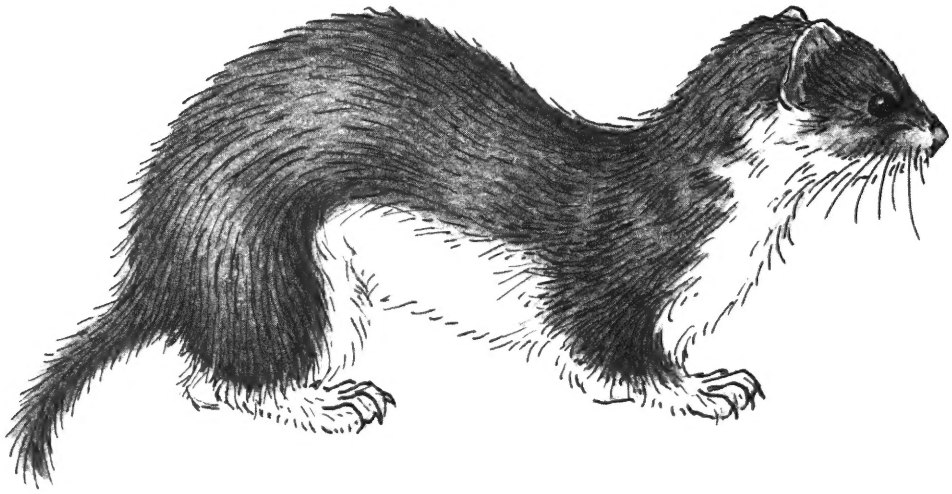
*Donald W. Webb, Mark J. Wetzel, and Loy R. Phillippe, Center for Biodiversity; P.C. Reed, and Timothy C. Young, Illinois State Geological Survey*

*Species Spotlight*

# Least Weasel

Susan Post

Least weasels, *Mustela nivalis*, are not only the smallest members of the weasel family, but also the smallest member of the Order Carnivora in the world. They do not appear to be common in any part of their range and usually pass unnoticed until one is trapped or revealed by tracks in fresh snow. They are found in Europe, northern Asia, North Africa, and North America. In North America they are found from Alaska and northern Canada, south to Wyoming and North Carolina. In Illinois they are found north of an east-west line running through Edgar–Adams counties. They can be found anywhere that mice and other rodents are plentiful. They will adapt to a variety of habitats, but prefer rolling or flat countryside, short-grass fields, and the edges of cultivated fields.



Least weasel (*Mustela nivalis*). Drawing by Aleta Holt

With their long, slender skulls and sinuous bodies, least weasels are built to squeeze into nooks and crannies. They are small enough to follow their favorite prey—mice—into their underground burrows. If their heads can fit into burrows, their bodies soon follow. They are diminutive in size, only seven inches long, and less than an inch in diameter with very short tails (about one inch in length). Weasels are brown with white under parts and toes. The tail tips contain a few black hairs. Their heads are long and oval shaped; the eyes are black and the ears short and pointy. Northern individuals are completely white in the winter, but in the eastern part of their range, from southern Michigan south, they may remain brown. They have a well-developed anal scent gland, which they use for marking territories and defense. In fact, the name weasel comes from the Old English word "weosule" which means flowing and refers to the musky secretions of the animal.

Least weasels are active any time of the year, day or night. They can run up to six miles an hour. When hunting they move about their home range (about two acres), investigating every hole and crack, even climbing trees or bushes to examine the nests of birds. The least weasel is a specialist on small mammals, eating mice, rats, and voles. Bird eggs, nestlings, and insects are also fair game. They consume about 40% of their body weight per day, eating 9 or 10 times each day. Pouncing on their prey, the weasels wrap their legs and bodies around victims, and then kill them with swift bites, usually at the base of the skull. Even if not hungry, least weasels will kill and store their excess food in side passages of their burrows.

Nests of least weasels are constructed of grasses lined with fur or feathers and have been found beneath corn shocks in shallow burrows bordering streams. They will even take over the nests or burrows of their prey species. Weasels will den in the abandoned burrows of other small mammals, such as a mice, gophers, or ground squirrels, adding a lining of mouse hair to any already present nesting material.

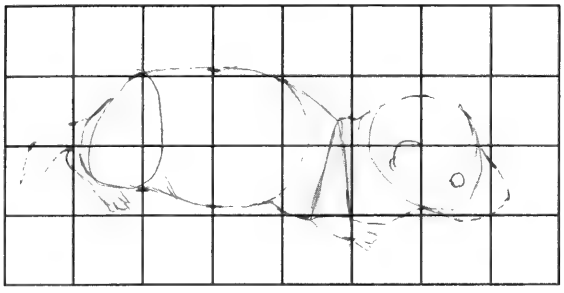
Lease weasels have at least two litters of young per year, each with one to six young. The young are born after a gestation of 34–37 days and are wrinkled, pink, and naked. Eighteen days after birth the young have fur and are eating meat. Their eyes will not open for at least another week. Within 40 days they can kill prey, and by 12 weeks they are fully independent and leave their families.

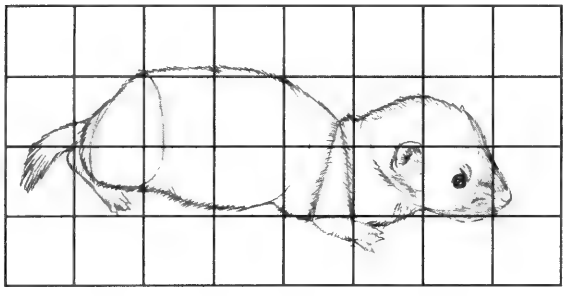
While hawks, owls, and foxes are important predators, the worst enemy of the least weasel may be a cold winter with no food.

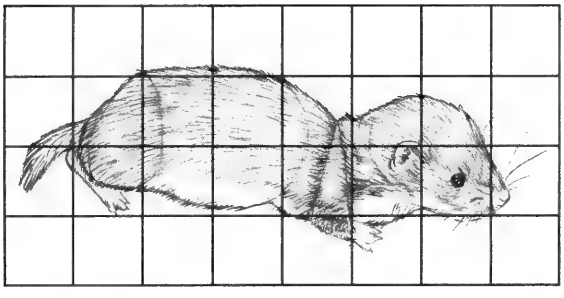
*The Naturalist's Apprentice*

# Scientific Illustration: Draw a Least Weasel

Carolyn Nixon







Scientific illustration is a form of art where the artist draws the subject to accurately represent it. One of the most difficult and most important steps in a scientific illustration is getting the correct shape of the subject. One trick used by many illustrators, including the famous wildlife illustrator John James Audubon, is to draw with a grid. Try to draw the least weasel shown here.

You will need a pencil, a ruler, and a letter-sized piece of paper. Turn your paper so that it is wider than long. Using your ruler, lightly draw a grid that has 1-inch squares. The grid should be 8 squares wide and 4 squares high.

Mark the general proportions of the weasel by putting short guide lines in each square, marking where the outline of the weasel crosses the grid and where it turns or angles within the grid.

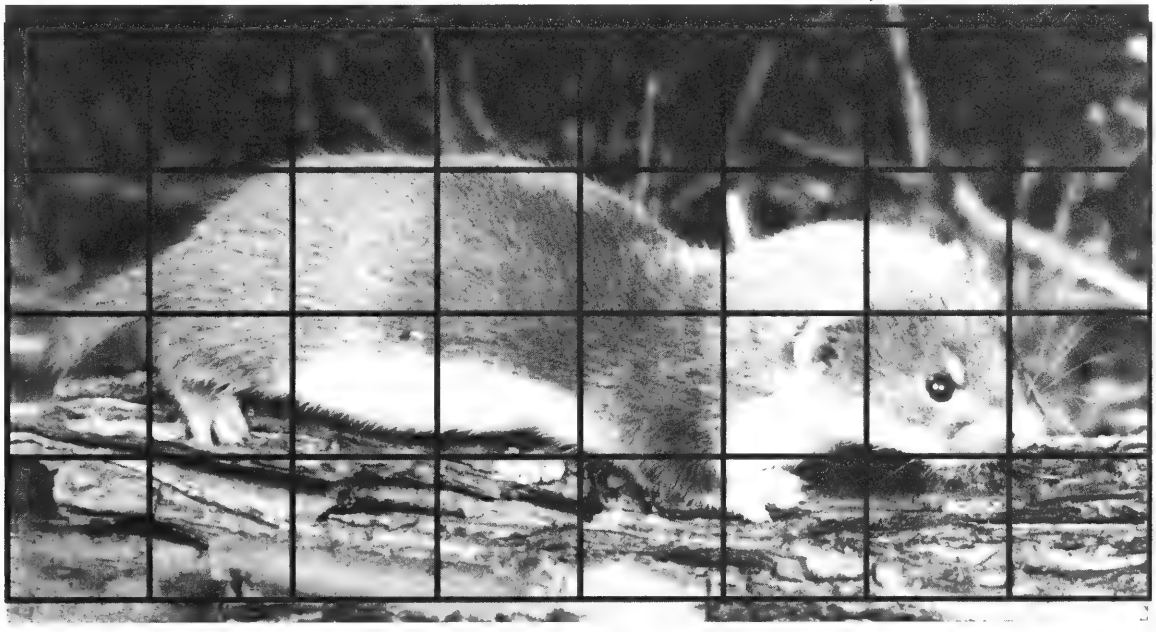
Look at the weasel photograph and determine if there are any common shapes within the shape of the weasel. These shapes can include circles, rectangles, or triangles. If you see these shapes, lightly sketch them into the grid. Draw any connecting lines to complete the shape of the weasel.

Fill in the eye with your pencil, making it dark by pressing harder. Make sure you leave some white highlights in the eye so that it will look alive. To make the weasel look furry, sketch short lines around the edges of the outline, making sure that the lines go in the direction of the fur.

To finish the drawing, fill in the areas of fur with short lines, again, in the direction of the fur. Use few lines in areas where the fur is white and more lines where it is dark. In darker areas of the fur, you can also press harder with your pencil to make slightly darker lines. Notice that the fur is longer on the tail. Make your lines longer here. As a final detail, draw the whiskers.

Congratulations! You have drawn a least weasel. You can use these same methods to draw any plant or animal. You can also draw your grid on a separate piece of paper. Make sure it is dark. Then tape a thin piece of paper over the grid. You should be able to see the grid through the top piece of paper. When you are finished drawing your subject, you can remove the grid.

Photo courtesy of Maslowski and Goodfaster, 1957



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# Armadillos

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counties and cities. The questionnaire asked if the recipient had observed armadillos in Illinois since 1990 and, if so, when and where. It also asked for information about other recent sightings that the recipient considered reliable. Because birders are so observant, we posted a request for armadillo sightings on the IBET birding listserve.

We received responses from 102 recipients of the questionnaire (65%). Twenty-one respondents (20.6%) knew of at least 1 armadillo sighting and 10 (9.8%) had observed armadillos personally. Several reports were received from other sources, including birders and highway workers. Very few sightings prior to 1999 were reported and most of the animals were roadkills. For 1999–2003 we determined that there were at least 76 different armadillo records from 22 counties. Most armadillos were seen in the western half of southern Illinois (west of Vandalia, I-57, and I-24). The northernmost areas with multiple sightings were near 39°10'N latitude in Calhoun and Greene counties. During 2004 armadillos have been observed in seven additional counties. How do armadillos get here? Some may be intentionally brought into Illinois and released. Others could arrive as "hitchhikers" on barges coming up the Mississippi, Illinois, and Ohio rivers; in railroad cars; or in trucks. Natural dispersal from Missouri also is possible. Armadillos can swim, but the Mississippi River is a formidable barrier. Perhaps they use bridges. Or, island-hopping might enable them to cross such a wide river in stages.

Next we need to determine if the armadillo has become established here (overwinters and breeds) or if there just has been a continual influx of individuals. If you spot an armadillo in Illinois, please send the location, date, and status (live or dead) to jhofmann@inhs.uiuc.edu.

*Hofmann, Center for Wildlife and Plant Ecology and Terry Esker, IDNR Division of Habitat Resources*

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ILLINOIS NATURAL HISTORY SURVEY

Reports

ILLINOIS NATURAL RESOURCES



Spring 2005
No. 383

INSIDE



# The Eastern Massasauga Rattlesnake at Allerton Park

The eastern massasauga rattlesnake (*Sistrurus sistrurus catenatus*) is one of the smallest rattlesnakes in North America, and by most accounts, it's also the rarest. In Illinois, only three or four populations remain; one of these is at Allerton Park in Piatt County.

At the time of European settlement, the massasauga could be found in New York, Pennsylvania, Ohio, Indiana, Ontario, Michigan, Wisconsin, Iowa, Missouri, and the northern two-thirds of Illinois. An 1893 account of the abundance of the massasauga in Illinois states: "On the prairies of Illinois, before the country became thickly populated, these reptiles were extremely abundant, and the killing of two or three dozen of them in a season was not an unusual thing for a farmer's boy. Now, in that same region, not one is seen in years." Thus, by 1893 the massasauga was already in decline and its status has only gone downhill since. Because of habitat destruction and outright persecution, it is found only in scattered colonies across its former range, where it is afforded legal protection at the state and province levels.

An adult massasauga rattlesnake residing at Allerton Park in Piatt County.
Photo by Chris Phillips, INHS Center for Biodiversity

Baby massasaugas found at Allerton Park.
Photo by Chris Phillips, INHS Center for Biodiversity

There have been records of sporadic encounters with massasaugas in the vicinity of Allerton Park and surrounding towns since 1937, but historically, *S. catenatus* probably existed all along the Sangamon River in Piatt and Champaign counties. In the early years of the operation of the Allerton Estate as a park by the University of Illinois, rattlesnakes were routinely moved from areas of high human traffic on the north side of the Sangamon River (such as the lawns and formal gardens) to the restored prairie on the south side. This practice continued into the early 1980s when the number of encounters on the north side dropped to less than one per year and then stopped altogether.

In spring of 2000, Eric Smith, a regional Heritage Biologist with the Illinois Department of Natural Resources, asked if it would be worthwhile to start searching for massasaugas at the restored prairie at Allerton. Because so many individuals had been moved to this area from across the river, it seemed reasonable to expect that some had survived. Organized searches utilizing volunteers were started in spring 2000, but no massasaugas were encountered. In June of 2000 a University of Illinois graduate student saw a massasauga sunning on one of his mammal traps near the Allerton prairie. This observation led to renewed efforts to find an adult

*Continued on back page*

# Wetlands of the Upper Sangamon River Watershed: Comparisons to the National Wetlands Inventory

Beginning in 2002, a comprehensive study of wetland habitat within the Upper Sangamon River watershed of central Illinois was initiated. Encompassing more than 1,400 square miles, the Upper Sangamon watershed is representative of many other watersheds within Illinois, dominated by rowcrop agriculture. Because of the large size of the watershed and uneven distribution of wetlands, sections (generally one square mile in size) were stratified and then randomly selected from across the watershed; 80 sections were investigated.

One aspect of this study was to compare existing wetlands to those identified in the National Wetlands Inventory (NWI). Conducted in the 1980s, the NWI was a comprehensive, remote sensing-based wetland mapping and classification scheme conducted across Illinois and the nation. Wetland data from the NWI are often referenced when discussing the status of Illinois wetlands. Wetlands in this study refer to "jurisdictional" wetlands only, those meeting the federal definition of a wetland. For example, many man-made ponds do not meet this definition.

Overall, the NWI mapped 371 wetland sites across the sampled area. Our study indicated that only 46% of these were actual wetlands. Only about 4% had been destroyed, but 50% had been misclassified as wetlands, when, in fact, they were not. A large part of this inaccuracy was attributable to wetlands identified as "farmed." Sixty-nine of these farmed wetlands were identified in the NWI; however, only three of these were actual, functional wetlands. The NWI also failed to identify 33 other wetlands.

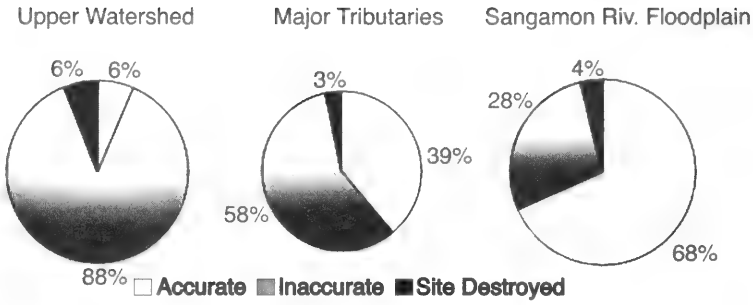


Figure 1. Percent of wetlands accurately identified by the NWI, percent identified by the NWI that were actually not jurisdictional wetlands, and percent destroyed since completion of the NWI in three regions of the sampled watershed: the upper reaches of the watershed, areas along major tributaries to the Sangamon River, and the Sangamon River floodplain.

Inaccuracy in the NWI was not evenly spread throughout the watershed (Fig. 1) or across wetland types (Fig. 2). Of the wetland sites identified by the NWI and associated with the Sangamon River and its floodplain, most were found to be jurisdictional wetlands. However, fewer of the NWI-identified wetlands associated with the major tributaries of the Sangamon River were determined to be actual wetlands. In the upper reaches of the watershed, a mere 6% of wetlands classified by NWI were found to be jurisdictional wetlands. Of the misclassifications in the upper reaches of the watershed, 70% were attributable to NWI-identified emergent wetlands that were farmed.

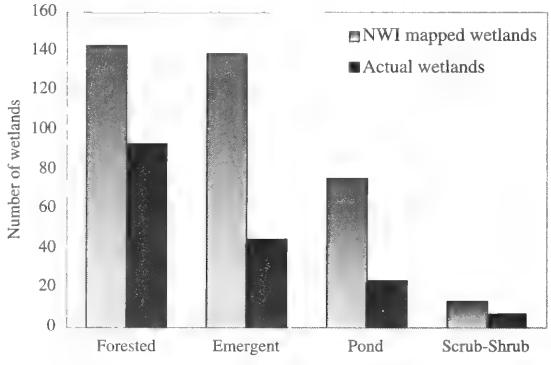


Figure 2. Number of forested, emergent, pond, and scrub-shrub (wet shrubland) wetlands identified by the National Wetlands Inventory in the sample area, and number of wetlands actually found.

From a wetland habitat standpoint, little has changed since the NWI. However, there is substantially less wetland habitat than suggested by the NWI. Although many of these sites still exist, particularly forests and ponds, they are not considered jurisdictional wetlands and, thus, are not afforded the protection status given wetlands. Also, recent regulatory changes have limited the protection for wetlands not associated with streams and rivers (such as many ponds), thereby making many of these wetlands even more vulnerable to destruction. The large number of farmed wetlands identified in the NWI is also very misleading. Although most of these sites, typically just shallow depressions in the landscape, still exist, it is inaccurate to consider them functional wetlands. They are farmed in all but the wettest years, are mostly unvegetated except for planted corn or soybeans, and provide virtually no wildlife habitat. In general, very little functional wetland habitat occurs in this watershed outside of the Sangamon River, its major tributaries, and their associated floodplains.

A stretch of the Sangamon River in central Illinois.
Photo by staff of INHS Center for Wildlife and Plant Ecology

*Brian Wilm, Jeff Matthews, Liane Cordle, and Jesse Kurylo, INHS Center for Wildlife and Plant Ecology*

# Arthropod Diversity in the Calumet Region

The Calumet region in southeast Chicago was once approximately 20 square miles of sand dunes, swales, and wet prairie forming one of the most significant wetland complexes in the Midwest. In 1848 the Illinois & Michigan Canal opened, connecting Lake Michigan to the Illinois River. This water passage connected the Great Lakes to the Gulf of Mexico and was the start of an industrial boom in the Calumet region. Over the next 100 years this flat grassy wetland felt the impact of the steel industry, railroads, and other industries such as brick, glass, paint, and petroleum products. When the steel industry collapsed in the 1970s, it and other area industries had left their impact on the entire Calumet region. Most undeveloped properties had suffered some level of environmental degradation. Most of this degradation came from the dumping of slag, industrial wastes, and dredge spoils from the Calumet River.

From 1980 to 2000 there was increasing interest in the Calumet, especially in the conservation of the remaining undeveloped sites. In 2002 the Calumet Ecological Management Strategy was adopted. This plan has two components, one industrial the other open space. It recommends approximately 3,000 acres for industrial development and 4,800 acres to become part of an open space reserve. Preserve, Improve, and Create (PIC) are three words that are at the heart of this plan for the Calumet Open Space Preserve. PIC presents a framework for land managers in the area. Preservation of the remaining higher-quality sites is a key component. Many of the highly degraded sites have been or are slated for transfer to the City of Chicago. Plans for these sites are to improve and create habitats on them. The goal is rehabilitation not restoration, the latter an impossible task.

Sites in the area that will undergo significant rehabilitation are Hegewisch Marsh, Indian Ridge Marsh, Marion Byrnes Natural Area, Van Vlissingen Prairie, Big Marsh, and Indian Creek. For most of these there is a list of plants, reptiles and amphibians, birds, and mammals but very limited data on invertebrates, with the exception of some groups such as butterflies and dragonflies.

A Black-crowned Night Heron at Heron Pond in the Calumet Region. **Photo by Michael Jeffords, INHS Office of the Chief**

During the spring, summer, and fall of 2001, Indian Ridge Marsh, Hegewisch Marsh, and Indian Creek were extensively sampled for invertebrates. The goal was to develop a baseline list of the species present prior to the planned rehabilitation efforts. A variety of sampling techniques was used varying from pitfall traps, malaise traps, vacuuming and sweeping vegetation, aquatic disc samplers, dredge bottom samplers, and black lighting. Insect material from these collections has been sorted to order and, when expertise was available, to family, genus, and species. For most orders it was not possible to identify the taxa to species; however, with the exception of the flies, all were sorted into morphospecies. Over 1,600 morphospecies were present. Flies were the most abundant group collected. No expertise could be found to work through these collections of flies; however, we did sort one of the largest collections taken in a malaise trap over a two-day period. In it were at least 120 different morphospecies. Based on the composition of this one sample, we estimate that 500 or possibly as many as 800 fly species may be in these collections. Two graduate students at the University of Illinois sorted through the parasitic wasps. Their final tally for this diverse group was over 900 morphospecies. These are insects that live parasitically on other insects. Although there is no data set available for comparison, this seems like a pretty diverse system.

How many taxa might there be in a higher-quality site in the area? Powder Horn Forest Preserve in the Calumet is the closest to presettlement conditions. A similar base level survey of this and two other sites began in 2003 and will continue for another year. As the collected material of these sites is sorted to morphospecies level, we will have the ability to compare species diversity and composition across sites with very different histories.

*David Voegtlin, INHS Center for Ecological Entomology*

# *In Memoriam*
# Frank C. Bellrose

World-renowned waterfowl researcher Dr. Frank C. Bellrose passed away from complications following surgery on February 19, 2005. He was 88 years old. Dr. Bellrose had a remarkable 67-year professional career that began at the Illinois Natural History Survey in 1938—an association that continued until his death.

Bellrose was born in 1916 in Ottawa, Illinois, on the Illinois River where he developed his lifelong interest in waterfowl and wetlands. He received his B.S. in zoology from the University of Illinois and began working for the Illinois Natural History Survey (INHS) in 1938. His extensive research studies conducted from the INHS field station located on Chautauqua National Wildlife Refuge near Havana, Illinois, included the migration and orientation of waterfowl; dynamics of waterfowl populations; life history, ecology, and management of the Wood Duck; ecology of aquatic and marsh plants; and the ecology of the Illinois River.

Bellrose began a study of Wood Duck nesting in the late 1930s. Eventually, he would develop predator-proof nest boxes. Wood Duck breeding biology, population dynamics, and evaluations of various types of nesting houses became career-long projects for Bellrose. He began a study of the ecology of aquatic, marsh, and moist-soil plants in the bottomland lakes of the Illinois River valley in the summer of 1938 and continued it periodically for more than 40 years. Through this long-term study, the detrimental effects of sedimentation upon the lakes of the Illinois Valley became apparent.

Bellrose initiated waterfowl surveys in the Illinois River valley from the ground in 1938. He began using a light aircraft in 1946, and the time required for a comprehensive inventory was greatly reduced, while the area covered was noticeably expanded. Waterfowl data, derived from these ground and aerial estimates, were incorporated into numerous studies. The aerial inventory of waterfowl continues to be an important part of the INHS waterfowl research program.

Pioneering work on lead poisoning as a mortality factor among waterfowl was one of Bellrose's most important contributions. His research was a major factor in the gradual replacement of lead with nontoxic shot for waterfowl hunting in the United States and other countries as well.

Bellrose's world-renowned book, *Ducks, Geese and Swans of North America*, was published in 1976 and has sold more than 350,000 copies. His latest book, co-authored with Daniel Holm, *Ecology and Management of Wood Duck*, was published in 1994. Both of these classic compendiums received The Wildlife Society's Book Publication of the Year Award. Bellrose published more than 110 scientific and popular articles. His name is virtually synonymous with "ducks" throughout the world.

In recognition of his long and productive career, Western Illinois University, Macomb, Illinois, awarded Bellrose an honorary Doctor of Science degree in 1974, and McMurray College, Jacksonville, Illinois, recognized him with a similar degree in 1995. He received the Aldo Leopold Award, the most prestigious professional award of The Wildlife Society, in 1985. February 1, 1988 was declared "Frank Bellrose Day" in Illinois by Governor James Thompson. In 1992, the Illinois Department of Conservation dedicated its Cache River Wetlands Project, which includes the Frank Bellrose Waterfowl Reserve. He retired from the INHS in 1982 but retained an Emeritus status and was active in waterfowl research until his passing.

The Waterfowl Research Laboratory of the Illinois Natural History Survey's Forbes Biological Station near Havana, Illinois, was officially named the Frank C. Bellrose Waterfowl Research Center in 1997. The naming of the Waterfowl Research Laboratory in his honor recognized the important contribution of Bellrose's work to waterfowl ecology and management throughout the world and the Illinois River where he spent his entire life and professional career. Other places named in his behalf include The Bellrose Preserve in southern Illinois, and Bellrose Island and Bellrose Trail near Havana. Alexander Griswald Marsh in Manitoba, Canada, was dedicated to Bellrose by the Illinois Chapter of Ducks Unlimited.

In 2001, Bellrose was selected as a charter inductee into the newly established Illinois Outdoor Hall of Fame, a program of the Illinois Department of Natural Resources' Illinois Conservation Foundation, in recognition of his lifelong commitment to natural resource protection and outdoor recreation in Illinois.

Bellrose's lifelong dedication to waterfowl research was a shining example to peers throughout the profession. His commitment to furthering our understanding of the waterfowl resource continues in the present with his recent revision of the classic *Ducks, Geese and Swans of North America*.

Frank was a common and compassionate person who was blessed with a love

*Continued on next page*

# Help Support Critical INHS Research through Donations

Tax deductible donations can be made to the following INHS funds via the Internet using credit cards. Please access our donations Web site at: <http://www.inhs.uiuc.edu/donation/index.html> and follow the instructions that you will find there.

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**Aquatic Biology Research Fund**

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This fund supports introductory or otherwise hard-to-fund projects concerning biodiversity in all its forms. For more information, contact Geoff Levin, Director of Center for Biodiversity (217-244-7481).

**Entomology for the Ages Fund**

This fund honors Dr. William H. Luckmann, who was a researcher and administrator for applied entomological programs at the Illinois Natural History Survey from 1949–1984. The Luckmann Award, first granted in 1994, is given annually to a student in applied entomology to support travel to a professional meeting. For more information, contact the INHS Center for Ecological Entomology at 217-333-6656.

**Philip W Smith Memorial Fund**

This fund, established by the family and friends of Dr. Philip W. Smith, honors his long and distinguished career at the Illinois Natural History Survey (1942–1979) and the University of Illinois (1965–1979). It supports research in all areas of natural history. For more information, contact Geoff Levin, Director of the Center for Biodiversity (217-244-7481), or visit www.inhs.uiuc.edu/~glevin/RossSmith.html.

**R. Weldon Larimore/Jordan Creek Award Endowment Fund**

Established by the family and friends of Dr. R. Weldon Larimore, this fund honors Dr. Larimore's long and distinguished career at the Illinois Natural History Survey (1946–current) and the University of Illinois (1969–1988). It supports research in stream ecology. For more information, contact John Epifanio, Chair of the Fund's selection committee (217-244-5059).

**Warren Brigham Memorial Fund**

This fund honors the memory of Dr. Warren Brigham, a leader in the application of GIS to natural history research and a specialist in aquatic beetles. It supports projects that involve computers and/or beetles with preference being given to proposals that make spatial information about water beetles available via the Internet. For more information, contact Mark Wetzel (217-244-2108).

**INHS Library Endowment Fund**

The goal of this fund is to help the library continue to build its excellent collection, which dates to the Survey's founding in 1858. The INHS Library serves a wide range of users, including Survey scientists, University of Illinois faculty and students, and the public. For more information, contact Beth Wohlgemuth, Librarian (217-244-4907).

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Part XIV
Subgenus *Onagrandrena*
Wallace E. LaBerge and Robbin W. Thorp

Part XV
Subgenus *Hesperandrena*
Robbin W. Thorp and Wallace E. LaBerge

Illinois Natural History Survey Bulletin
Volume 37, Articles 1 and 2
March 2005

*Illinois Natural History Survey Bulletin* 37(2):1–93
A Revision of the Bees of the Genus *Andrena* of the Western Hemisphere
Parts XIV (Subgenus *Onagrandrena*) and XV (Subgenus *Hesperandrena*)

by Wallace E. LaBerge and Robbin W. Thorp

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**Illinois Natural History Survey Publications**

The serial publications of the Survey have a remarkable history. *The Bulletin* has been published continuously since 1876, and *Biological Notes*, since 1933. Each issue of these research-oriented publications is mailed to various scientific and educational institutions throughout the world; additional copies are requested by ecologists, conservationists, and others throughout the nation. *Circulars*, by contrast, are usually "how to" publications written for a general audience. *Manuals*, published at irregular intervals since 1936, provide detailed descriptions and illustrations of a particular group of species, such as wildflowers or freshwater mussels. The content of *Special Publications* varies widely; recent sample subjects include a landowner's guide to amphibian conservation and the history of the Forbes Biological Station.

A list of all publications in print can be viewed at:
http://www.inhs.uiuc.edu/chf/pub/index.html

# Bellrose

*Continued from previous page*

for nature and an unlimited curiosity to unravel its mysteries. His passions were waterfowl and the Illinois River, both of which received his undivided attention for more than 70 years. Wherever ducks or the Illinois River are discussed, one name is always mentioned—Frank Bellrose.

Frank's timing was remarkable. He was the right person at the right time at the right place. Frank began his career at the birth of wildlife management and research, and he shepherded them through infancy to maturity. Few have had that good fortune. The Illinois Natural History Survey provided Frank the unrestrained opportunity to exercise his relentless pursuit of nature's mysteries in an era when little was known and recorded.

Dr. Stephen P. Havera, a long-time colleague of Bellrose recollected, "I noticed that wherever I went, whether it was professional meetings, banquets, duck clubs, or just a gathering of waterfowl people, that if Frank was present everyone would gravitate toward him. If Frank wasn't there, it wasn't long before I heard the inevitable question – 'How's Frank?' To me, that example of personal magnetism and a simple question captures the essence of respect and friendship Frank had among all walks of life.

"Although waterfowl was Frank's passion, his family was his love. He told me numerous times that another award doesn't mean anything, that his family and what people thought of him as a person were much more important."

Frank and his wife, Esther, traveled extensively throughout North America. They were blessed with two sons, Ron (Sandra) and Frank Jr. (Becky), and four grandchildren.

In 2002, in keeping with Frank's lifelong commitment to habitat and wildlife, the Bellrose family protected a segment of their farm along Sugar Creek in Logan County by dedicating it in perpetuity as the Sandra Miller Bellrose Nature Preserve.

Memorials can be made in Frank Bellrose's honor to: The University of Illinois—Frank C. Bellrose Waterfowl Research Center, and sent to: Illinois Natural History Survey, Frank C. Bellrose Waterfowl Research Center, P.O. Box 590, Havana, Illinois 62644.

*Stephen P. Havera and April Burgett, INHS Center for Wildlife and Plant Ecology*

*Frank Bellrose in his office at the INHS Forbes Biological Station near Havana, Illinois.*

*Bellrose poses with the* Anax, *once a floating laboratory for studies of the Illinois River.*

*Bellrose installs a Wood Duck nesting box that he developed in the 1940s.*

*Bellrose examines a nesting box on the Mississippi River at Nauvoo, Illinois.*

*Species Spotlight*

# Fairy Shrimp

Susan Post

"This woodland pond is temporary, created by snowmelt. By midsummer, evaporation will have claimed its contents and only a low spot in the forest will recall the pond of April."

Larry Weber
*Backyard Almanac1996*

Temporary pools, variously called vernal, ephemeral, or seasonal, are a type of wetland once common in the landscape. These pools developed from the scouring process of the ebb and flow of flooding rivers, streams, and lakes; through wind action; or from depressions created by trees that tip over. These pools are shallow, temporary, and separated from streams and rivers. Their defining characteristics are that they periodically dry up and do not contain fish. While the drying may occur annually or only in drought years, by late summer they are usually dry. It is this temporary aspect of these wetlands that make them valuable. The wet-dry cycle prevents fish from becoming established, allowing for critical breeding and rearing habitat for amphibians, insects, and crustaceans, including the fairy shrimp.

Two Illinois fairy shrimp swimming in an ephemeral pool. Photo by Michael Jeffords, INHS Office of the Chief

Fairy shrimp are crustaceans with gills, head and thorax fused into a cephalothorax, and two pairs of antennae. In temporary pools fairy shrimp are easily identified. They are 0.5 to 1.5 inches long, with stalked compound eyes, two sets of antennae, and 11 pairs of leaflike swimming legs. Fairy shrimp can range in color from translucent whitish to blue, green, or red-orange. Their coloration is determined by the food supply in the pool. Microscopic organisms such as algae, bacteria, and protozoa, along with bits of detritus are the main food supply. The movements of the shrimp's legs serve not only as a means of obtaining food, but also aid the shrimp in taking up oxygen from the water.

Fairy shrimp move along the bottom or glide about gracefully (usually upside down) by beating their legs, resulting in a wavelike front-to-back motion. Sometimes they rest on the bottom or drift slowly; other times they dart rapidly.

Reproduction begins when the male clasps the female with his antennae. The pair may swim clasped together for several days, but once mating occurs the male dies. A female can produce two types of eggs—summer and winter. Summer eggs are produced if there is a shortage of males. They are thin-shelled and hatch rapidly. The young from these eggs populate the pool the same season they are laid. Winter eggs are thick-shelled and once released, fall to the bottom of the pool. These eggs can withstand unusual amounts of heat, cold, and desiccation. When the pool refills in the spring, these eggs usually hatch in 1–2 days after being exposed to water. Winter eggs can be carried from pool to pool by traveling animals or by the wind if the pool dries out completely.

The egg hatches as a nauplius (a type of crustacean larvae) and develops in a series of instars. The fairy shrimp continues to molt until it reachs 20 segments. The speed of development tends to reflect the amount of time water remains in the pool, but is usually around 16 days.

Due to their ephemeral nature, fairy shrimp have few predators. The limiting factor in fairy shrimp populations is the need for 1 part per million dissolved oxygen in the water they inhabit and, of course, the temporary pools.

# The Naturalist's Apprentice Teachers' Page

**Drawing credits**: A, B, F, G, H by Carie Nixon; C from *The Crayfishes and Shrimp (Decapoda) of Illinois*; and D, E from Dover Clip-Art

**ANSWERS—From next page**

**1-D, 2-H, 3-C, 4-A, 5-B, 6-F, 7-E, 8-G**

# Illinois Crustaceans

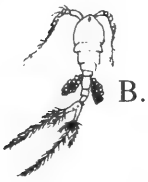
Carolyn Nixon

Many species of crustaceans live in Illinois, most of them in or near the water. See if you can match the drawings on the left with the names and descriptions of the groups of common crustaceans that can be found in Illinois. Write the letter of each animal in the blank on the left of its matching description below.

A.

1. _____ **Fairy shrimp** (anostracans) appear to swim upside-down, with their many swimming legs reaching upward from the body. They only appear after spring rains and must complete their life cycle before the pools dry up. The eggs withstand drying and freezing to hatch when the area floods again, sometimes years later.

B.



2. _____ **Crayfish** (decapods) have 10 pairs of legs. The first pair has large, pincherlike claws or chelae. They resemble lobsters.

3. _____ **Freshwater shrimp** (decapods) have 10 pairs of legs like their crayfish cousins, but the pincherlike claws are much smaller. They are slightly flattened laterally (from side-to-side).

C.

4. _____ **Water fleas** (cladocerans, such as *Daphnia*) are round, tiny crustaceans that swim with their long antennae. They give birth to live young, which can be seen inside the transparent shell of the mother.

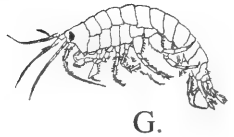
D.

5. _____ **Water fleas** (copepods, such as *Cyclops*) are tiny crustaceans that are difficult to see without a microscope, and are considered plankton. They have large heads that taper to an elongate body. There is often a single eye on the head.

E.

F.

6. _____ **Seed shrimp** (ostracods) are tiny crustaceans that have their entire body enclosed within a clamlike shell. The shell has two halves that are hinged along the back. They often crawl along sediment or vegetation in water. They sometimes swim in the water column by beating their antennae.

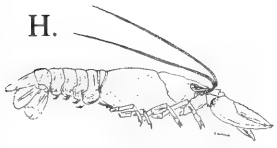


G.

7. _____ **Pill bugs and sowbugs** (isopods) are either aquatic or terrestrial. The terrestrial species are usually found in moist areas, such as under logs and leaf litter. The pill bugs can roll into a ball when disturbed.

8. _____ **Scuds or side swimmers** (amphipods) are small, shrimplike crustaceans that burrow in loose sediment and plant debris in still water. They are very flat from side to side and scuttle along through the sediment on their sides.

H.



**Answers and drawing credits on preceding page**

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# Massasaugas

*continued from front page*

snake. In 2001, Eric Smith organized another spring search after prescribed burns, but without a single massasauga encounter. Finally in April 2002, volunteers Don Shepard and Fran Harty observed an adult male massasauga basking near a crayfish burrow, the snake's probable hibernation site. This was the break we had been waiting for because we could now implant this snake with a radio transmitter and follow his movements using a receiver. Massasauga males actively search for females during the breeding season, usually July through September, and we hoped that our male snake would lead us to females that might be avoiding our detection with their superb camouflage abilities. Our telemetered snake, nicknamed Al, turned out to be an excellent tracker, leading us to two females by the end of the first summer. Since then, Al has led us to the same two females each year. Both females have given birth over this period, one giving birth twice in three years. We took photographs of the unique dorsal patterns of most of these young snakes and are hoping to recapture them in the coming years.

Even though we have only been able to track one snake at Allerton, the data we have collected on Al's daily movements and the habitats he is found in have already provided input into management decisions made at the prairie. For example, half of the prairie is burned every spring. We have been able to help the managers choose a burn date based on Al's position in his burrow. If he is close to the surface, we postpone the burn until it is cooler and he goes deeper. We also have gathered information on Al's use of the burned and unburned halves of the prairie. He uses the unburned half exclusively until the vegetation grows up and then he may move into the burned half. But most importantly Al has allowed us to find the two females and to document successful reproduction. This is a very important piece of information for addressing the future viability of the Allerton population. With more then 20 neonate snakes documented over the past three years, the future of the eastern massasauga at Allerton looks much brighter than it did just a few years ago.

*Chris Phillips, INHS Center for Biodiversity*

Illinois Natural History Survey Reports is published quarterly by the Illinois Natural History Survey, 607 East Peabody Drive, Champaign, IL 61820. Headquartered on the campus of the University of Illinois at Urbana-Champaign, the Survey is a division of the Illinois Department of Natural Resources.

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SURVEY

Reports

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Summer 2005
No. 384

INSIDE





# The Art and Science of Communicating Nature

*It can take years to refine one's photography, drawing, and writing skills. In a semester's time I was able to confidently learn the basics of each skill so that I can now go and explore and practice these skills further on my own.* —Peter Frank, NRES 499 student

The term "interdisciplinary" appeared in the halls of higher education some years ago, but is still in some circles regarded as a departure from serious study, as if the world were naturally compartmentalized. What is often forgotten is that most disciplines we regard as discrete entities today once were not. The most striking example is that of art and science. Leonardo Da Vinci, Lewis and Clark, and Darwin all documented their discoveries using sketches and written observation, often with what we might now consider an "artistic" eye.

"Communicating Nature" participants pose outside Dixon Mounds Museum. **Photo courtesy of Cindy McGrew**

U of I students John Marlin and Emma O'Brien collaborate in a drawing exercise of the NRES 499, "Communicating Nature" course. **Photo by Michael Jeffords, INHS Office of the Chief**

A new course at the University of Illinois this spring was created with the intention of bridging that modern art/science gap and teaching science students to depict their findings artistically for a lay audience.

NRES 499, "Communicating Nature," was a collaborative effort by three Illinois Natural History Survey scientists: Dr. Michael Jeffords, Susan Post, and Carolyn Nixon. The course proposed that empirical methods are not always sufficient to describe the natural world, and can in fact be somewhat myopic. The lofty goal was to encourage students to "analyze with the mind of a scientist, see with the eyes of an artist, and speak with the words of a poet."

The first step in communicating nature is truly to pay attention to it. Though the course was divided into the three disciplines of photography, writing, and drawing, all of the instructors focused on the fundamental skill of observation. Post, the writing instructor, insisted that students have a 3" x 5" notebook on hand at all times. They were to take weekly notes on anything that struck them, as well as the circumstances of the encounter: the date, season, weather, and location. These notes can provide the raw material for a completed piece, as shown by Post's own book, "Hiking Illinois," which began as two shoeboxes filled with these little notebooks.

*Continued on back page*

# Possible Displacement Mechanisms in Non-native Crayfishes

The influx of exotic species into Illinois has been continual since European settlers first set foot in the state. Many exotic species do not become established or have minimal impacts on our natural resources; however, some can have significant detrimental effects on native flora and fauna once established. One exotic species that falls into that second category is the rusty crayfish (*Orconectes rusticus*). The rusty crayfish is native to Ohio, Indiana, and Kentucky and was first discovered in Illinois in 1973. Through its use as fishing bait, the rusty crayfish was introduced into approximately a dozen sites in northern Illinois over the next 12 years. Since then the species rapidly spread across northern Illinois and in the process has eliminated populations of the native northern clearwater crayfish (*Orconectes propinquus*) and reduced populations of the native virile crayfish (*Orconectes virilis*). In other states the rusty crayfish has been shown to also reduce populations of sport fishes by consuming those fishes' eggs and by eating vegetation used by juvenile sport fish for refuge. Over the past 30 years, Illinois Natural History Survey (INHS) researchers have documented the slow spread of the rusty crayfish across Illinois' river basins. However, equally important as documenting range expansions of exotic species is determining the mechanism or mechanisms by which exotics are able to successfully displace native species. Once these mechanisms are understood, steps can be taken by resource managers to minimize or even stop the spread of exotic species. A new research effort by INHS staff is attempting to determine which mechanisms are at work in Illinois' crayfishes.

Experimental evidence gathered by other researchers suggests that several processes may play a part in crayfish displacements. These include faster growth rates by invading crayfishes and a subsequent "upper hand" in competing for food and shelter, differing susceptibility to fish predation by native and non-native crayfishes, and the dilution and eventual extinction of native species genes by hybridization events with non-native species.

An additional possible displacement mechanism is simple resource competition, and INHS researchers are beginning to examine food resource use by non-native versus native crayfishes in Illinois streams. Crayfishes have been reported to eat a wide variety of food items such as algae, rooted aquatic plants, decaying leaf litter, insects, and even small fish. By measuring carbon (C) and nitrogen (N) isotope ratios in body tissue, one can determine what types of food resources an organism has been consuming over an extended period of time. For example, organisms with relatively high ratios of $^{15}N$ to $^{14}N$ are thought to reside higher on the food chain than those with lower ratios, and $^{13}C$ to $^{12}C$ ratios provide information on carbon sources (e.g., aquatic versus terrestrial plant material). Isotope ratios can thus give a clearer picture of the long-term diets of organisms since other methods of diet analysis, such as examining gut contents, are limited to what animals have eaten in the past 24 to 36 hours. Using museum records housed in the INHS Crustacean Collection, researchers have identified streams in Illinois where rusty crayfish have occurred for longer than 25 years, less than 5 years, and streams that are currently being invaded by that species. By taking tissue samples of crayfishes in these streams, in addition to those from streams not yet invaded by rusty crayfish, and analyzing isotope ratios in those tissues, INHS researchers are hoping to determine if food resources play a role in displacement. Specific questions to be addressed are what food items invading rusty crayfish and native crayfishes consume, is there any overlap in diet requirements, and if so, are species with greater dietary overlap more likely to be displaced. By examining sites where rusty crayfish have been established for several years, INHS researchers also hope to learn if the diets of these exotic invaders change once they become established and eliminate native crayfish.

The rusty crayfish is native to Ohio, Indiana, and Kentucky and was first discovered in Illinois in 1973. **Photo courtesy of C. Lukhaup**

The rusty crayfish is already well established in the northern half of the state and there is currently no known means to eradicate it. The continued education of anglers on the negative effects of rusty crayfish and the undesirability of dumping unused bait is one of the best ways to slow the spread of that species. However, INHS researchers hope to able to determine if food use plays a role in invasion dynamics. Once the diet of invading rusty crayfish has been identified, stream sites more susceptible to invasion could potentially be identified and extra efforts taken to prevent the introduction of that species. The potential also exists for reducing or eliminating newly established populations of rusty crayfish by manipulating the availability of certain food resources.

*Christopher A. Taylor, Center for Biodiversity and David J. Soucek, Center for Ecological Entomology*

# Nutrients in Illinois Streams

Anthropogenic eutrophication persists as a major problem for U.S. waters despite progress in reducing nutrient discharges from point sources over the last 30 years. Excessive levels of nutrients continue to be consistently identified as a reason why as much as half of U.S. waters fail to meet water quality objectives. Illinois waters are not exempt from the problem of eutrophication; a growing population, expanding suburbs, and intensive agricultural activities are responsible for substantial loadings of phosphorus and nitrogen into Illinois waters.

Cultural inputs of nutrients are responsible for excessive growths of microscopic and macroscopic plants, which then create a cascade of conditions detrimental to both aquatic ecosystems and their beneficial uses by humans. Uncontrolled algal growth can result in water bodies that are visually unattractive and odorous, and extensive growths of filamentous algae and macrophytes physically interfere with fishing and boating in affected water bodies. The unbalanced growth of algae caused by cultural eutrophication affects numerous ecosystem parameters as well. Large standing crops of algae cause large diurnal (24-hour) swings in dissolved oxygen and pH, which then can have severe repercussions for sensitive fish and invertebrates. Even when dissolved oxygen levels are adequate, eutrophication affects higher trophic levels by skewing communities toward massive populations of grazers such as stoneroller minnows and midge larvae. Excessive algal growth can also alter fish and invertebrate communities by changing the nature of the benthic substrates.

The U.S. EPA is in the process of requiring Illinois and other states to establish nutrient criteria for streams and rivers. Under provisions of section 304(a) of the Clean Water Act, the EPA has produced a set of suggested nutrient standards that will protect aquatic ecosystems. The U.S. EPA has encouraged state agencies (e.g., Illinois EPA) to suggest alternative quantitative criteria that are based on scientific research. In response to Illinois' need for a scientific underpinning for nutrient standards, the Illinois Council on Food and Agricultural Research (CFAR) funded a Water Quality Strategic Research Initiative (SRI) to specifically address phosphorus issues in Illinois streams. Scientists from the Illinois Natural History Survey (INHS), led by Dr. Walter Hill, are collaborating with researchers from the Illinois State Water Survey and the University of Illinois on CFAR-funded projects investigating the role of phosphorus in stream eutrophication. These researchers are attacking a number of poorly known aspects of stream eutrophication that hinder the development of nutrient criteria. INHS researchers are focusing on establishing a quantitative description of the relationship between phosphorus loading and algal growth in streams. Unlike the situation in lakes, it is currently impossible to predict what effect a given reduction in phosphorus will have on algal growth in streams. The levels of phosphorus needed to cause excessive algal growth are, at best, imprecisely known, and the effects of other algal-limiting factors (e.g., turbidity, floods, temperature, nitrogen, grazers, etc.) on the phosphorus relationship to algal growth are unclear. INHS researchers have established a three-pronged research attack to address these unknowns: (1) statewide surveys of algae, nutrients, and associated ecosystem parameters; (2) intensive research and monitoring in Little Kickapoo Creek to take advantage of the nutrient input by the new Bloomington sewage treatment plant; and (3) nutrient addition experiments in streamside channels and laboratory streams. Other issues investigated by researchers funded by the CFAR Water Quality SRI include the role of phosphorus regeneration in stream sediments and conditions under which excessive phosphorus loading leads to dissolved oxygen problems.

Uncontrolled algal growth can result in water bodies that are visually unattractive and odorous. **Photo by Michael Jeffords, INHS Office of the Chief**

*Walter Hill, Center for Aquatic Ecology and Conservation*

# How Does Suburbanization Influence Pest Problems?

Suburbanization is the outward expansion (or movement) of development away from the main portion of a city into previously uninhabited areas, including farmland and wooded forest. Suburbanization is, in general, the result of people wanting to escape the city confines by living several miles (or more) away. The construction of housing developments and shopping malls or "strip malls" continues to increase at a rapid pace due to the demand for rural-type living. New subdivisions are typically built in semi-wooded habitats where a diversity of insects and animals have resided for years. However, encroaching into uninhabited environments puts humans into direct competition with nature. In order to survive, insects and animals compete for food and space. As suburban sprawl encroaches into areas previously occupied by insects and wildlife, this leads to increased calls to pest control operators and lawn-care professionals by homeowners. In general, the people who live in subdivisions are well-to-do and don't want to deal with insects and wildlife in their homes or landscapes.

New housing developments commonly have pest problems due to the installation of trees, shrubs, flowers, and turfgrass, which are watered and fertilized regularly—thus providing an abundance of food or habitats for many insects and wildlife. Some common insect pests include ants, termites, wasps, wood-boring insects, and mosquitoes. Wildlife pests include skunks, raccoons, and deer.

A combination of insects and wildlife can lead to major problems for homeowners. For example, many new housing developments have large expanses of highly-maintained turfgrass that are irrigated regularly, providing an ideal environment for Japanese beetle, *Popillia japonica,* females to lay eggs. The larvae or grubs that hatch are a viable food source for skunks and raccoons that destroy the lawn while searching for the larvae. Then the homeowner wants to know what can be done to alleviate the problem.

New subdivisions and businesses are being built on land that was once used in growing agriculture crops such as corn and soybean. Herbicides were most likely applied to these fields in order to reduce problems with weeds. However, what is the impact on landscape plants that are exposed to these soils that may contain herbicide residues? It is possible that herbicide residues may stress trees and shrubs enough to increase their susceptibility to wood-boring insects.

Landscapes containing a variety of plant material, especially trees, shrubs, or flowers in the rose family may experience problems with deer because these plants provide abundant food that is easily accessible to the animals. Building wooden homes in previously forested areas where termites or ants exist provides abundant food for these two insect pests. Termites will feed on the wood and ants, depending on the species, will enter homes in search of food or nesting sites. Suburbanization may also artificially create conditions that place undue stress on plants as well as influence natural control by predators and parasitoids. For example, construction activities near tree roots can result in soil compaction, a change in grade, and/or a change in soil pH. All these conditions can injure the root system of plants—increasing stress on pre-existing trees or shrubs. This kind of stress increases plant susceptibility to wood-boring insects.

Building developments that encroach on unihabited areas put humans in direct competition with wild animals and plants. **Photo by Charlie Warwick, INHS Office of the Chief**

Shopping mall plantings of trees, shrubs, and ground covers are typically located near buildings or in parking lot "islands." These plants are surrounded by concrete or asphalt, which absorb and radiate heat, creating a microhabitat that may create stressful conditions, which increases susceptibility to insect pests including scales, aphids, and spider mites. In addition, these microhabitats, which are typically warmer than the surrounding areas, increase the reproductive potential of insect and mite pests. These microhabitats or "islands" are also inhospitable to natural enemies such as predators and parasitoids due to the extreme temperatures, volume of dust, or levels of automobile exhaust. The plants may be so isolated that natural enemies cannot locate the pests. This is referred to as "fragmentation." For example, mugo pines planted in parking lot "islands" are typically heavily infested with pine needle scale, *Chionaspis pinifoliae*, because natural enemies are unable to locate the scale populations. The question then is: will this result in an increase in insecticide usage? The best way to avoid fragmented landscapes is through proper plant selection, that is, using resistant plant material and incorporating a diversity of plants into a landscape as opposed to pure monoculture plantings.

Suburbanization will continue to be a dominant factor as housing developments and shopping malls expand beyond the cores of cities. However, it is important for humans to understand that just because we inhabit a new area it doesn't mean we will not have pest problems. We will never eradicate insect pests—they were here first and many are a vital part of the established ecosystem.

*Raymond A. Cloyd, Center for Ecological Entomology and the University of Illinois*

# Are Small, Isolated Prairie Preserves Sustainable?

The tallgrass prairie with all its complex interactions among plant and animal species and environmental variables has nearly vanished from Illinois. Prairie remnants are disproportionately found on nutrient-poor sites or other lands with limitations to agricultural development. Remnants on the rich silt-loam soils are particularly scarce due to extensive conversion to agriculture. Prairie remnants persisting on these rich soil types mostly occur in railroad rights-of-way or on lands associated with pioneer cemeteries. Vehicle incursions, abundant weed infestations, fire absence, and continued losses due to agricultural expansions continue to threaten remnants in the railroad rights-of-way. The remnants associated with pioneer cemeteries tend to be small (< 5 acres), isolated, rectangular units, surrounded by agricultural and other land uses where prairie species are absent. However, these areas offer the greatest opportunities to preserve the floristic composition characteristic of the original silt-loam prairies, and many of the best remaining examples have been protected as Illinois Nature Preserves.

Most prairie remnants in Illinois are found along railroad rights of way or in pioneer cemeteries. **Photo by John Taft, Center for Wildlife and Plant Ecology**

Important questions remain: are these small and isolated sites sustainable or is there attrition from the pool of prairie species? Will these species persist in the absence of interactions with many bird and mammal species or even some insect pollinators? Can these sites survive offsite influences such as herbicide drift and do they resist invasion of weedy species from surrounding lands? To answer these questions, a study begun in 2001 was designed to determine current patterns of plant species diversity and assess trends in three high-quality remnants of the rich silt-loam prairies of Illinois. These preserves, Prospect Cemetery Prairie, Loda Cemetery Prairie, and Weston Cemetery Prairie, range in size from three to four acres.

The vegetation was quantitatively surveyed using the standard quadrat sampling frame— 50 cm on each side, placed along six parallel transects. The transects were placed in a stratified order across each preserve. Metal rebar posts mark the beginning and end points of each transect.

Based on these sample data, total richness of native plants ranged from 98 to 109 species with total richness of non-native species ranging from 13 to 30 (13% to 28%) at Loda, Weston, and Prospect, respectively. The average number of native species per quadrat (species density) was similar across sites ranging from 13.2 to 14.5/quadrat in the core interior portions of the prairies. Loda Cemetery Prairie, the only site with no grave markings in the preserve, had the greatest native species density and the lowest proportion of non-native species and appears to be the site with the fewest on-site disturbances.

The first signals that changes which could threaten these preserves may be underway would be differences in patterns of diversity and composition between external and internal portions. The profile of native plant species richness across each site forms a consistent arching pattern with peak diversity in the internal portions. Analysis of the compositional differences between these zones indicates that the edge plots include a greater proportion of weedy species including many woody vines. Comparisons of native and non-native species richness between the "edge plots" in the external 10 m of each preserve and "interior plots" indicate the differences are more than expected from random chance, with native species diversity greater in the internal zones and non-native species greater in the external zones. In most cases (excepting patterns for non-native species at Loda), the contrasts are statistically significant.

These results provide a baseline estimate of species diversity and abundance patterns as a means to make future comparisons. Since such descriptions from this historically species-rich region of the tallgrass ecosystem are surprisingly scarce, these characterizations also provide comparative information for studies of other grasslands. Results from resampling efforts will indicate whether trends show an increase in edge-type vegetation at these preserves or whether on-site management is adequate to sustain these important relicts of our natural heritage. If the trends indicate attrition from the pool of prairie species, there will be strong justification for attempting to acquire adjacent lands to augment the prairies with borders of reconstructed prairie to buffer them from some of the effects of edge.

*John B. Taft, Center for Wildlife and Plant Ecology*

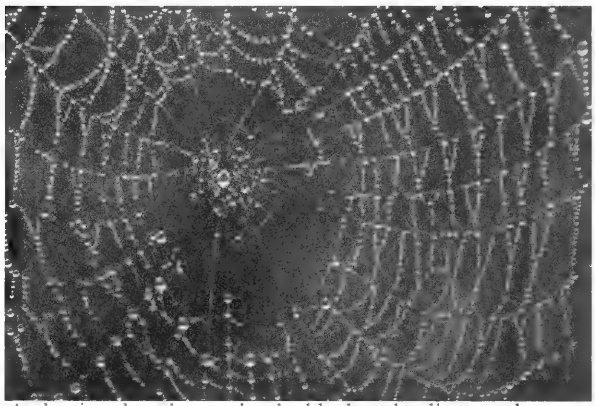
*Species Spotlight*

# Black and Yellow Garden Spider

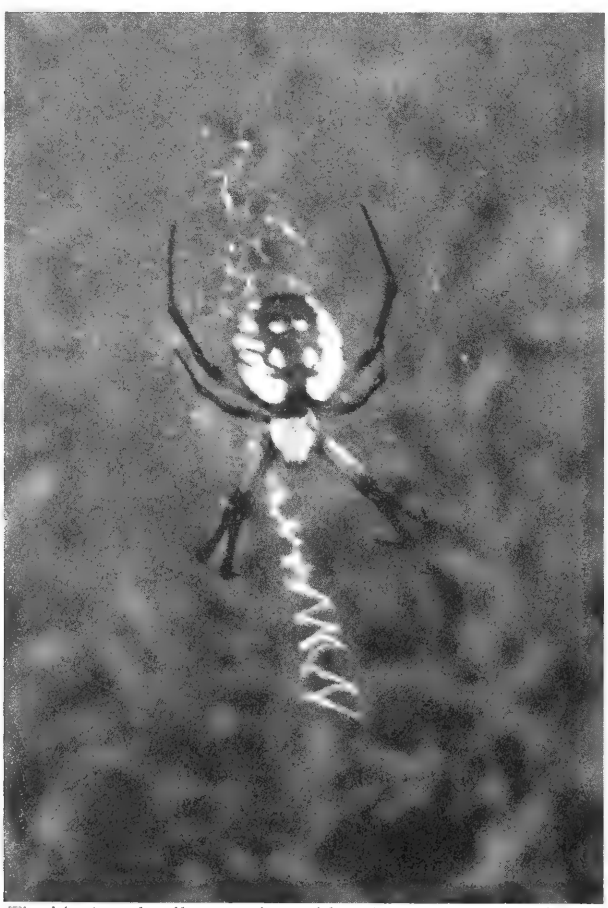
Susan Post

Almost anyone who has ventured into an oldfield or even a garden in late summer has undoubtedly had a close encounter with an imposing yellow and black female garden spider. Her large size, bold colors, and habit of sitting rather menacingly in the center of a large web, nearly always built in open, sunny locations, make the garden spider easily recognizable. Such encounters are unforgettable, if not downright startling.

The black and yellow garden spider, *Argiope aurantia*, is one of two species of garden spider found in Illinois. *A. aurantia* are found from southern Canada, south through the lower 48 United States, Mexico, and Central America. They are found as far south as Costa Rica. These spiders have egg-shaped abdomens with yellow or orange markings on black backgrounds. Their legs are black with the upper portions orange. Like most spiders, the females are larger 19–28 mm, while the males are 5–8 mm.



A classic orb web spun by the black and yellow garden spider. **Photo by Michael Jeffords, INHS Office of the Chief**



The black and yellow garden spider, *Argiope aurantia*, is one of two species of garden spider found in Illinois. **Photo by Michael Jeffords, INHS Office of the Chief**

Garden spider webs are of the classic orb design—a central hub with a geometric arrangement of spirals and strengthening threads radiating from the center like the spokes of a wheel. This design forms a strong, yet flexible structure up to two feet in diameter, making it a highly efficient interceptor of flying or jumping insects as large as grasshoppers. Adding to this efficiency is the unique zigzag pattern of shiny white silk extending from the center of the web. This was once thought to be a warning device to prevent birds or other animals, perhaps even the inattentive gardener, from blundering into the painstakingly constructed web. However, recent research suggests an even more ingenious purpose. Because it reflects ultraviolet light much like flowers that use these signals to attract insects for pollination, the structure may actually be sending an irresistible invitation to insects. They may fly into the web thinking they are headed to a flower rather than onto a dinner table!

Once snared in the web, the insect's struggles are sensed by the female, who has been lying in wait, with her head downward and legs outstretched to better detect even the faintest hint of a meal. She deftly moves to the source of vibration and quickly restrains the captured prey by wrapping it in silk before biting and injecting it with paralyzing venom. This ready-to-eat package is then moved to an out-of-the-way portion of the web so it will not interfere with later catches. The hapless insect can then be sucked dry at the spider's leisure.

In spite of their impressive sizes and seemingly ruthless demeanor, garden spiders are harmless to humans and should be seen as allies in the garden, even when they cause us heart palpitations in the tomato patch! This Illinois resident will perish with the first hard freeze, leaving only a brown, fuzzy egg cocoon filled with tiny spiderlings that must await the coming spring.

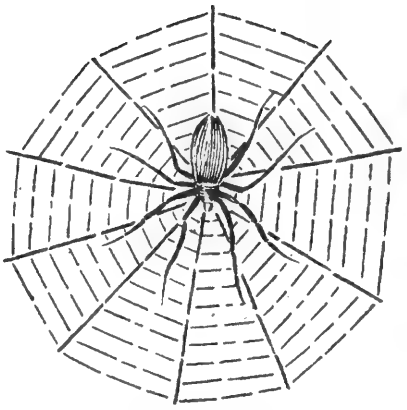
*The Naturalist's Apprentice*

# Capture a Garden Spider's Web

Carolyn Nixon

Capture a Garden Spider's Web

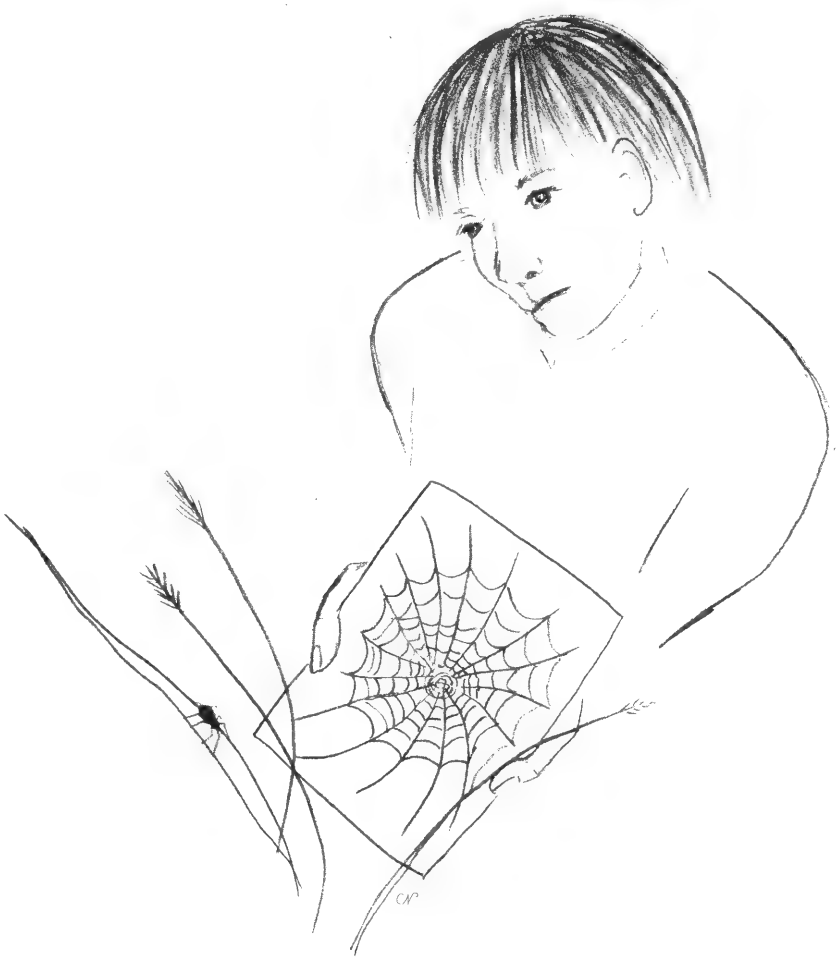
A spider web is a truly beautiful piece of natural art, and you can capture a garden spider's web and preserve it on a piece of paper. You will need a can of quick drying spray paint, a piece of stiff paper such as poster board, a pair of scissors, and several newspapers. Use a dark-colored paint, such as black or brown, if you use white or light colored paper; use white paint with dark-colored paper.



Find a nicely formed spider web. It will work best if it is not wet from dew or rain. Cut your paper so that it is larger than the web. If the spider is present, shoo it from the web. You do not want to injure the spider as it is beneficial to the habitat. The spider will make a new web once its old one is gone.

Hold the can of paint about a foot from the web and spray it at an angle to the web. Spray paint on both sides. Have a partner hold up a piece of newspaper to catch the paint that misses the web. Quickly place your piece of stiff paper against the web, lifting the web onto it. Have your partner cut the long silk threads that hold the web to the supporting plants.

Lay your collected web on a flat surface for several minutes while the paint dries. Write the date and location where you collected the web on the paper, and the species of spider, if you know it. You can either spray the collected web with clear acrylic to protect it or place it in a picture frame with a piece of glass or plastic in front of it.



Drawing by Carolyn Nixon, INHS Center for Ecological Entomology

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# Communicating Nature

*continued from front page*

Much of the course was designed to help students see the natural world and their own capacities anew. A sample exercise consisted of drawing from an upside-down image. Nixon, the drawing instructor, feels that this activity forces the artist to examine the actual contours of a subject, freeing him or her of the mind's preconceived notions of, say, a duck. Many of the students were shocked at how effective their drawings turned out, when viewed right side up.

Coupled with observation, of course, is the fundamental act of recording. Recording requires tools, and students spent a good deal of time practicing the basic skills in each genre. As the photography instructor, Jeffords emphasized the importance of precision. An image that is perfect in all other respects will still fail if it is blurry. He taught photography as a matter of levels, grounded in basic technical knowledge of the equipment, proceeding to artistic variables (depth of field, perspective, etc.) and finally to pure aesthetic tools (e.g., composition). He removed the mystery from creating striking images by breaking the process down and showing that the aim is to be thorough and thoughtful at every level.

Hands-on experience was an important part of the course. There were three field trips: to Matthiessen State Park and Lodge Park in Illinois and Turkey Run State Park in Indiana. Here students learned to distinguish between theory and practice. Birds aren't cooperative drawing models, wind-blown plants are challenging to photograph, and it's hard to make a description of a sunset cliché-free. Students realized that after learning the fundamentals of any art, the payback comes with practice.

NRES 499 involved near constant peer review, in class as well as through an on-line forum. The culmination of this process, and indeed of the entire course, will be a real-world exercise in communicating nature. Watch for the Fall 2005 issue of the *Illinois Steward*. Every article, drawing, and photograph in the issue will be the work of this pioneer group of NRES 499 students. The enthusiasm of the students as well as the quality of their work demonstrate that there is a need for courses such as this one. The idea is not so outlandish, in the end, since higher education was initially intended to provide just this—a truly well-rounded education.

*Andrea Appleton, Office of the Chief*

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ILLINOIS NATURAL HISTORY SURVEY

Reports

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Autumn 2005
No. 385

INSIDE





# Agricultural Systems in Transition to Organic Production: A Progress Report

What began as a dream ("if we plant it, the research support $$ will come") became reality in 2003 for researchers at the Illinois Natural History Survey (INHS) and University of Illinois trying to jump-start a multi-disciplinary program on organic farming systems. Feedback from organic growers during an INHS-sponsored workshop was key to development of the farming systems strategies that form the basis of the research. Also important was availability of land for long-term organic research [*INHS Reports* No. 375:1,8 (2003)]. We submitted a proposal in March, initiated crop rotations for the research at the Champaign field site in June, collected baseline data, and waited to hear if the proposal would be funded. The gamble paid off: USDA grant support for the four-year project on organic transition was awarded in September 2003.

During the three-year transition from conventional to organic production, growers must adopt practices that increase crop diversity, enhance soil biological activity and nutrient cycling, support beneficial organisms, and rely on cultural and biological methods of pest management. Based on their individual farm operations, growers have several options to choose from in deciding how to transition their land for organic certification. The farming systems approach of our project compares nine transition schemes that differ in management intensity (i.e., frequency of disturbance through tillage, increased number of crops) and organic matter inputs. Three treatments (farming systems) represent different cropping intensities: 1) high-intensity transition (intensive vegetable production), 2) intermediate-intensity transition (organic cash-grain), and 3) low-intensity transition (perennial pasture mix). Within these are three sub-treatments (types of amendments) representing different strategies for organic matter and fertility management: a) plant inputs only (cover crops providing all organic inputs and nitrogen fertility), b) plant inputs plus composts, or c) plant inputs plus manure. Our research objective is to determine how these transition schemes affect ecosystem components such as weeds; soil organic matter and nutrient availability; soil invertebrate communities; and the relationship among soil fertility, plant health, and insect/disease pressure.

*Research intern Juan Carlos Laso (L) and graduate student Carmen Ugarte (R) take soil samples in the broccoli-cabbage plots at the INHS organic research farm in Champaign.* Photo by Edmond Zaborski, INHS Center for Ecological Entomology

Now at its midway point, the project has been quite a learning experience. We have consulted

*Continued on back page*

# Creating an Emiquon Corps of Discovery

*"Glacially slow, combines engulf the golden vegetation, leaving nothing behind but dust—twenty-first century loess—a dusty, dirty ballet, choreographed in green and brown, producing rivers of gold. The dust will soon settle, just as it did 10,000 years ago, to create a new beginning of infinite possibilities. Not thirty seconds after the final combines have passed, a mayfly alights on my back, poised and ready for a river of a different kind—the long process has begun. The mayfly flutters away to rest on a windswept bit of grass. What it looked like perched on corn, as it obviously was a few seconds ago . . . I can only speculate."*

—Excerpt from the author's journal and an example of descriptive writing practiced by Emiquon Corps of Discovery members.

The restoration of The Nature Conservancy's (TNC) Emiquon Preserve over the next decade provides a unique opportunity for dedicated citizens to participate in the documentation of the dramatic changes that are likely to occur. The Emiquon Preserve, once a spectacular lake/wetland complex (consisting largely of the former beds of Thompson Lake), was leveed and drained in the early part of the 20th century and has been farmed ever since. The 7,775 acres, purchased by TNC in 2000, are now in the early stages of restoration. While the demise of these historic wetlands was documented by Illinois Natural History Survey Scientists (INHS), and its restoration will also be closely monitored by them, we felt Emiquon needed an additional perspective. It is perhaps ironic that 200 years ago Illinois served as the start of one of the greatest explorations undertaken on the North American continent—the Lewis and Clark Expedition. This two-year exploration of the American West generated the most famous nature journals ever compiled. To document the evolution of Emiquon over the next decade, we developed an "Emiquon Corps of Discovery" (ECD), consisting of individuals trained in the skills of photography, descriptive writing, and sketching/drawing who will create a total aesthetic picture of Emiquon. The 2005 ECD differs from the Lewis and Clark expedition in a fundamental way. That Corps of Discovery traveled thousands of miles to document the landscape and its organisms. At Emiquon, it is the landscape that will evolve and change and the individuals who will stay put.

This project developed as a unique partnership among INHS, TNC, and the Dickson Mounds Museum, Lewistown, IL. Members of the ECD were trained in a series of workshops at the museum, beginning in January 2005. The 45 students, citizens with a diversity of skills and experience, attended four all-day Saturday workshops in late winter and early spring. Course instructors (all from INHS) were Dr. Michael R. Jeffords, photography; Susan L. Post, descriptive writing; and Carolyn P. Nixon, sketching and drawing.

The basic idea for the ECD was put forth by Jo Skoglund, TNC, while the instructors at INHS developed the course entitled "Communicating Nature."

Mayfly resting on corn stalk. **Drawing and watercolor by Michael Jeffords, INHS Office of the Chief**

Historically, scientists, restoration specialists, and land managers have communicated their research findings through scientific literature, book chapters, textbooks, summary articles, and technical reports. These venues have often been the only outlet for their work, realistically meaning that most science is generally not available to a lay audience. Such venues also fail to engage the community at large in the restoration process.

In communicating scientific findings, we have found that journal articles seldom succeed in presenting the total complexity or aesthetic appeal of nature to a wider audience. An important dimension is left undescribed. Communicating this dimension requires a different skill set than those typically taught to scientists. These skills are more closely associated with the artistic realm than with the scientific. Today's higher educational system seldom places value on these artistic skills that are invaluable for education and outreach. Thus, graduates are not prepared when opportunities and necessities arise for them to present their work outside the scientific world.

The ECD has not ignored science, however, merely for the sake of aesthetics. To provide a systematic approach to the Emiquon documentation, a series of Aesthetic Points and Pathways (APPs), analogous to scientific sampling points and transects, were developed for the ECD. Thus, over time, corps members will be able to show systematic change at Emiquon, filtered through their own creativity. There are no rules governing the APPs, except that the time, date, and direction of the observations be noted. The ECD is a long-term project with additional opportunities for members to experience further creative growth following the completion of formal training. To showcase the changes that occur, the ECD, in conjunction with the instructors and museum staff, will develop a yearly exhibit of their works for display at Dickson Mounds Museum.

We believe this project provides powerful motivational activities that not only promote an understanding of the basic science involved in major restoration, but also create an environment where issues such as biodiversity, conservation, and environmental ethics can flourish. We aim to add a creative dimension that will contribute to the total picture of the evolving landscape that is Emiquon.

*Michael R. Jeffords, INHS Office of the Chief*

# On-line Identification Tools for Leafhoppers

*The Leafhoppers, or Cicadellidae, of Illinois*, by D.M. DeLong, published in the *Bulletin of the Illinois Natural History Survey* in 1948, included descriptions and identification keys for approximately 350 species known to occur in the state. Although nearly 60 years out of date, this work remains the most comprehensive guide to this diverse and economically important group of insects in the midwestern U.S. Excluded from this work was the large leafhopper subfamily Typhlocybinae, which comprises at least another 600 Illinois species and includes agricultural pests such as the potato leafhopper and various grape leafhoppers.

No attempt at a comprehensive taxonomic treatment of Illinois Typhlocybinae has ever been made, in part because the group comprises some very large and taxonomically difficult genera, each containing several hundred species. One of these genera, *Erythroneura*, comprises 600 described species, 441 of which are recorded from Illinois, and 52 of which are, so far, known only from this state. Species of this genus are distributed throughout the temperate regions of the Northern Hemisphere.

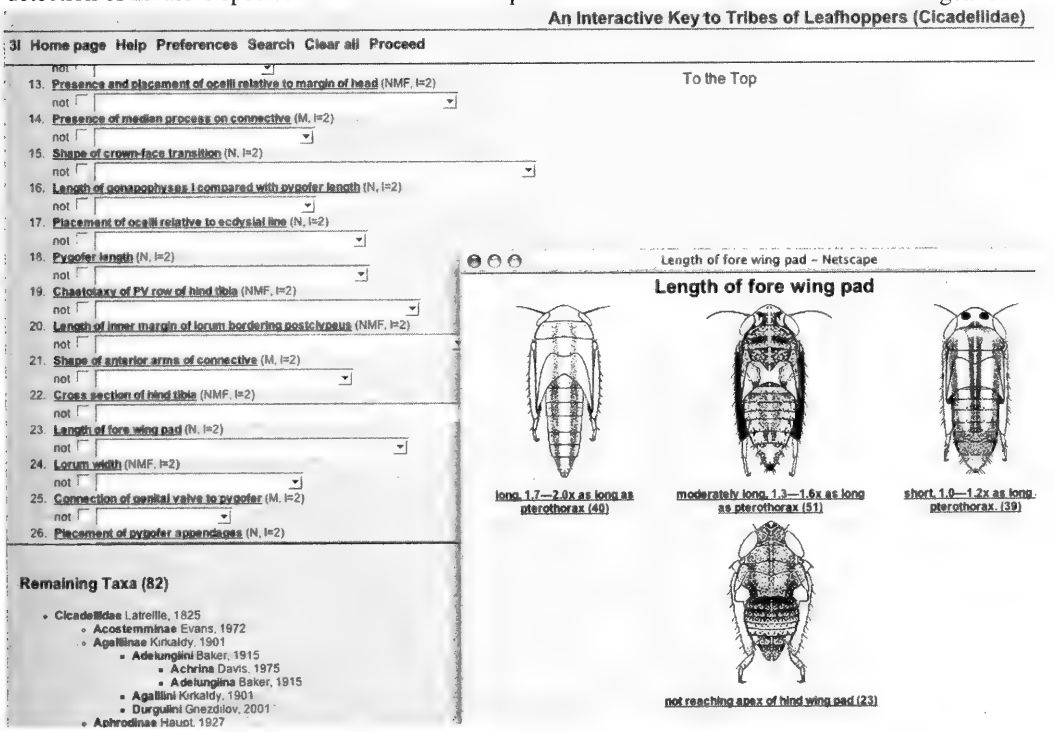
Rapid and accurate identification of species in such groups is crucial to early detection of invasive species and effective management of natural resources, but remains difficult or impossible because of the lack of user-friendly identification tools and the shortage of expert taxonomists. Fortunately, technologies now exist to streamline the process of synthesizing and managing taxonomic information (e.g., nomenclature, comparative morphological data, specimen distribution records), enabling biologists to create efficient tools for identifying species even in hyperdiverse groups such as insects.

With funding from a National Science Foundation initiative called "Revisionary Syntheses in Systematics (REVSYS)," INHS Center for Biodiversity entomologists Dmitry Dmitriev and Chris Dietrich are addressing these problems by developing new Internet-accessible tools for identifying insects and summarizing information on their geographic distributions and ecological associations. Their initial efforts are aimed at synthesizing morphological, distributional, and ecological information for leafhoppers, with particular emphasis on species of the genus *Erythroneura*.

Among the tools being developed are illustrated interactive identification keys. Unlike traditional dichotomous keys that require the user to examine sometimes obscure morphological features in a particular order, the user of an interactive key may select any morphological feature in any order. Each feature mentioned in the key is linked to one or more images that facilitate interpretation of terminology. This greater flexibility and user-friendliness minimizes mistakes because the most distinctive features of a specimen may be taken into account first when attempting an identification. Additional tools linked to the on-line keys automatically create species descriptions, distribution maps, and tables of host plant associations using information retrieved from a specimen database.

So far, label data have been entered and geo-referenced for over 80,000 *Erythroneura* specimens from collections throughout the U.S. and Canada, nomenclatural information has been compiled for 1,890 species of *Erythroneura* and related genera, and an archive of more than 6,300 digital images has been created. A dataset comprising more than 100 morphological features for each species is also being compiled and these data are being used to construct an interactive identification key for *Erythroneura* species and to estimate the phylogeny of the genus. The taxonomic tools developed as part of this project will not only facilitate the first comprehensive treatment of *Erythroneura* species, but will also provide infrastructure to support future projects focusing on a wide variety of diverse but poorly studied organisms. Example interactive keys and other taxonomic tools are available on-line at: http://ctap.inhs.uiuc.edu/dmitriev/.

*Chris Dietrich and Dmitry Dmitriev, Center for Biodiversity*




Sample screen from on-line interactive key for leafhoppers at http://ctap.inhs.uiuc.edu/dmitriev/.

# Aerial Inventories of Waterfowl in Illinois

I've often wondered if Dr. Frank Bellrose knew he would be starting an Illinois tradition when he climbed into a military aircraft in 1946 and experimented with estimating waterfowl abundance from the air. Indeed, Bellrose's technique was a good one; his foresight preceded the aerial surveys conducted annually throughout the U.S. and Canada, and the Illinois Natural History Survey (INHS) has conducted these flights in Illinois regularly since 1948. At the INHS Forbes Biological Station, we informally mark the onset of fall when our phone starts to ring frequently with hunters inquiring about the latest counts.

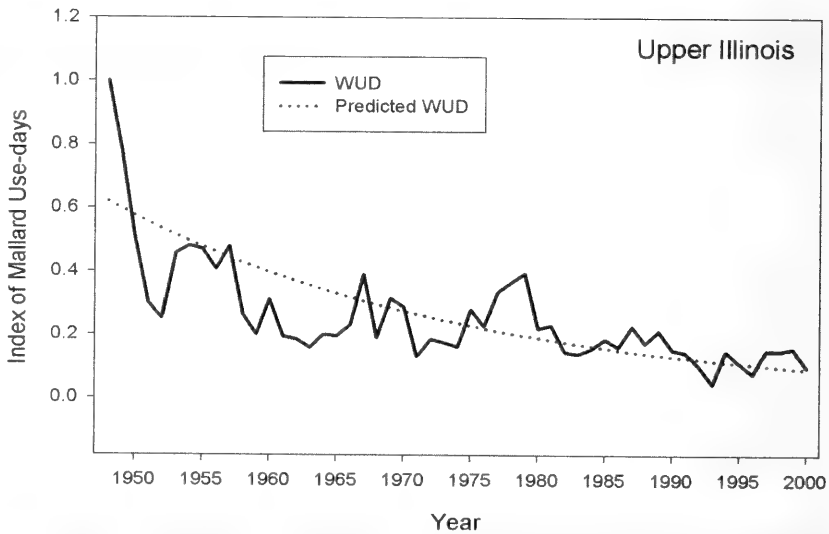
Although hunters are keenly interested in fall inventories of waterfowl, these inventories serve a greater purpose than satisfying curiosities. For example, the Illinois Department of Natural Resources relies on these data to guide selection of waterfowl hunting season dates and frameworks each year. Additionally, these data were used extensively by Dr. Steve Havera to describe abundance and distribution of ducks and geese in his 1999 book, *Waterfowl of Illinois: Status and Management*. And since I was hired by the INHS about a year ago, we've been digging deeper to see what else this long-term dataset might tell us about these economically and ecologically important birds.

The most obvious use of these data is for identification of trends in waterfowl abundance over time and space. However, this task may not be as straight-forward as it sounds. For example, the INHS waterfowl inventories, as currently conducted, only provide an index of abundance, not a formal population estimate. Additionally, observers may be differentially biased in their duck counts; fortunately, there have only been 3 observers in 56 years of inventories. Finally, duck abundance fluctuates over time, and trends are typically not linear. To address these issues we are estimating waterfowl population trends using recent advances in mathematical modeling, referred to as Generalized Linear Mixed models. This class of statistical models allows us to fit nonparametric trends to the data that incorporate random effects (in this case as an "observer" effect) and account for temporal autocorrelation (i.e., repeated measures within inventoried sites). These techniques are more than statistical "smoothing;" to the contrary, they offer a robust method to address analysis of long-term trend data without ignoring important caveats such as nonlinearity and bias.

Preliminary results may not surprise many folks. For example, Mallard abundance decreased about 3% per year from 1948–2000 in the Illinois River valley. Interestingly, other dabbling duck species appear to have increased significantly over time. For example, Gadwall abundance increased an average of 8.1% per year during the period 1948–2000 in the lower Illinois River valley, likely reflecting dramatic continental population increases during the last two decades. Other trends seemingly reflect restoration successes. Specifically, Canada Goose abundance increased about 3% per year on the inventoried portions of both the Illinois and Mississippi rivers.

*Continued on next page*

Dr. Frank Bellrose (left, INHS) plotting the course of a flight in 1946 with Vernon Conner (center, USFWS) and Robert Brough (right, INHS). Photo courtesy of INHS Forbes Biological Station



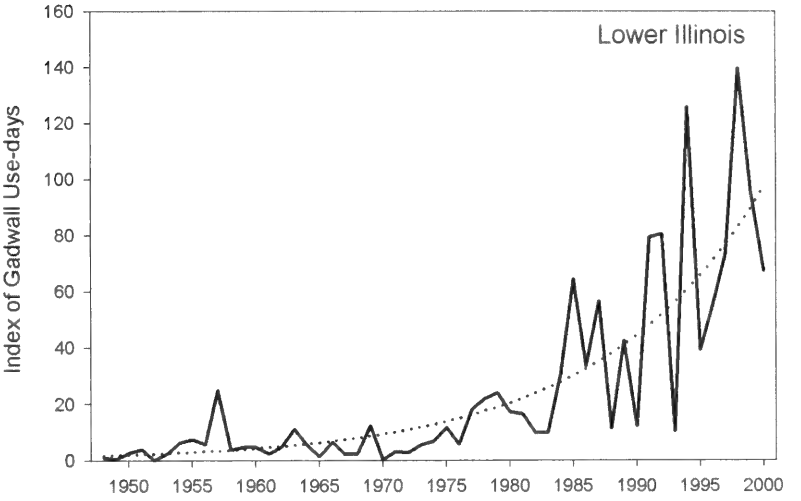

Trend of Mallard abundance (fall use-days) in the upper Illinois River valley, 1948–2000. Index values (y-axis) were computed using 1948 use-day estimates as the base year. The average annual decline in abundance was significant (-3.6%; 95% CI = -5.9 to -1.3%; P = 0.0027).

# Aerial Inventory

*Continued from previous page*

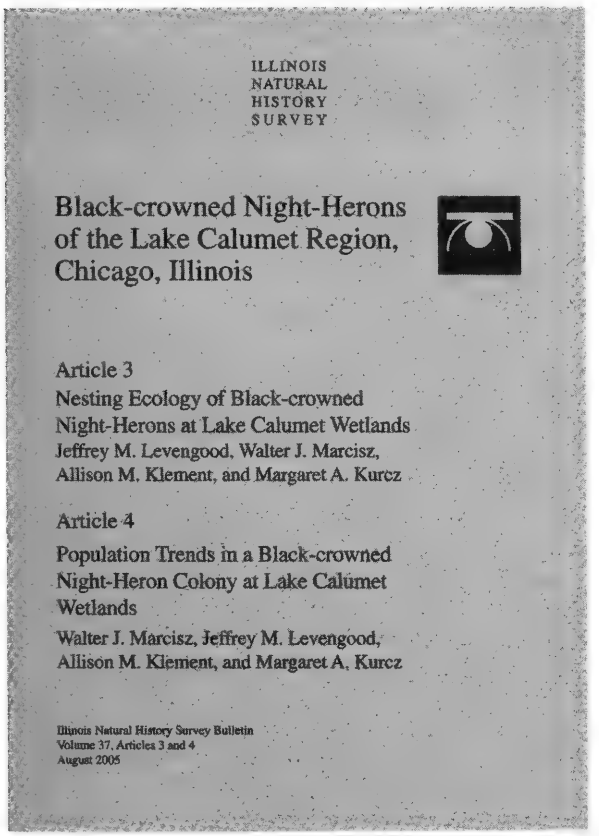
Of course, there are many possibilities to incorporate the existing data into other analyses. Currently, we are attempting to model waterfowl abundance during fall and spring in relation to wetland characteristics to explain variation in abundance among surveyed locations. We are also using these data as covariates in an analysis of waterfowl hunter success on some public hunting areas in Illinois. In the future we hope to model waterfowl abundance in spring and fall in relation to annual, site-specific wetland conditions derived from historical aerial photographs and other data. Although our efforts to further analyze this dataset are ongoing, one thing is certain: this fall we'll begin our 57th year of aerial inventories!

*Joshua D. Stafford, Center for Wildlife and Plant Ecology*




Trend of Gadwall abundance (fall use-days) in the lower Illinois River valley, 1948–2000. Index values (y-axis) were computed using 1948 use-day estimates as the base year. The average annual increase in abundance was significant (8.1%; 95% CI = 5.6 to 10.7%; P < 0.0001).

# NEW INHS PUBLICATION




*Illinois Natural History Survey Bulletin* 37(3&4):95–118,
Black-crowned Night-Herons of the Lake Calumet Region, Chicago, Illinois
by J.M. Levengood, W.J. Marcisz, A.M. Klement, and M.A. Kurcz

softcover, $10.00 per copy

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*Species Spotlight*

# Black Vulture

Susan Post

The Black Vulture is a large, broad-winged, soaring scavenger, most abundant in the southeastern United States. In Illinois it can usually be found year-round in extreme southern Illinois. The birds' requirements are simple—a steady supply of carrion and sites for nesting and roosting. Its scientific name, *Coragyps atratus*, is a combination of Greek and Latin. The genus name comes from the combination of two Greek words, *korax* (raven) and *gyps* (vulture), while the species name, *atratus* (clothed in black), is Latin.

Black Vultures are about 25 inches in length and have 57-inch wingspans. Their tails are short and squared off. The birds have been described as looking like "shabby undertakers." They are black overall with gray, featherless heads and necks. Their naked heads and necks prevent the fouling of their feathers while the birds feed on decaying carcasses and the bald heads may also be an adaptation to help the birds regulate body temperature. They have dark, meat-tearing beaks and thick gray legs. Their feet are adapted for walking on the ground and, in contrast to their flight, their movement on the ground is not graceful. To walk, they slightly spread their wings, take a long step with one foot then put the other foot down, so that the birds give the impression of hopping.

Their wings are black, except for a few outer flight feathers (primaries), which are white. When the wing is extended these primaries appear as white patches near the outer edges of the wings. Black Vultures are silent birds as they lack a syrinx, the vocal organ of birds. Hissing, grunting, and blowing are the extent of their vocabulary.

Black Vultures spend most of their days in flight searching for carcasses. They usually feed on roadkill, and will visit farms, ranches, land fills, and shorelines; any areas where carrion can be found. Live prey can be taken and there are records of them feeding on baby turtles, nestling herons, and even newborn calves. Unlike their close relative the Turkey Vulture, Black Vultures do not have a well-developed sense of smell so their foraging strategy depends on keeping other foragers such as the Turkey Vulture in view. They will follow other birds and soon large feeding aggregations will form. Black Vultures will even dominate Turkey Vultures at a carcass.

Once food is located, the birds use their strong beaks to rip the meat off a carcass while holding it down with their feet. To reach the internal organs they insert their heads and necks entirely into the carcass. While they prefer fresh dead, they will eat meat in various stages of putrefaction. There is something in the birds' gut that provides resistance to microbes and toxins found in decaying flesh. Thus the belief that vultures spread anthrax is false. Due to the uncertainty of their next meal, these birds can rapidly ingest large quantities of food and then go for days without feeding.

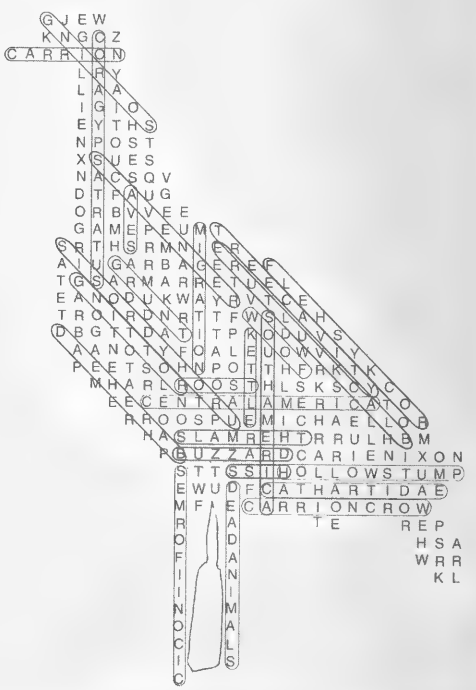
Black Vultures form long-term pair bonds after a courtship ritual. In 1840 Audubon described this ritual as, "the gesticulations and parade of the males are extremely ludicrous. They first strut about somewhat in the manner of the Turkey Cock, then open their wings, and approach the female, lower their head, its wrinkled skin becoming loosened, so as entirely to cover the bill, and emit a puffing sound, which is by no means musical." Black Vultures are solitary nesters using dark caves, deep crevices in cliffs, hollow trees, or abandoned buildings to lay their eggs (usually two). No nest is made. Once the eggs hatch, the adults will feed the young regurgitated food from their crops. The chicks fledge at 8 to 13 weeks but may still associate with the parents for several more months.

Black Vultures are not birds of prey. Their claws are weak, they do not catch what they eat, and their beaks are not strong enough to rip fresh meat. Instead, vultures are in the same order as storks and herons. Like members of this group, vultures practice urohydrosis, where they squirt liquid excrement onto their legs for an evaporative cooling effect.

The Black Vulture, *Coragyps atratus* Photo by Steve Bailey, INHS Center for Wildlife and Plant Ecology

## The Naturalist's Apprentice Teachers' Page

Answers for Black Vulture Word Search on following page.



# Black Vulture Word Search

Carolyn Nixon

Black Vulture Word Search

The words that are in ALL CAPITAL LETTERS in the list below are hidden in the vulture shape. See how many you can find.

**Classification of Black Vultures:**
AVES (class of animals that includes all birds)
CICONIIFORMES (order of birds that includes vultures, herons, and storks)
CATHARTIDAE (family of birds that includes vultures and condors)
*CORAGYPS ATRATUS* (species name for Black Vulture)

**Common names for Black Vultures:**
BLACK VULTURE
CARRION CROW
BUZZARD

**Black Vulture feeding habits:**
SCAVENGER
CARRION
GARBAGE
DEAD ANIMALS
ROTTING

**Habits and features of Black Vultures:**
MIGRATION
SOARING
KETTLE (a group of vultures soaring on thermals)
THERMALS
UROHYDROSIS (a not so pleasant vulture method of keeping cool)
ROOST
BARE HEAD

**Black Vulture nesting sites:**
TREE CAVITY
HOLLOW STUMP
ROCKY SHELF

**Sounds that Black Vultures make:**
HISS
GRUNT
WOOF

**Black Vulture wintering places:**
CENTRAL AMERICA
SOUTH AMERICA

ILLINOIS
NATURAL
HISTORY
SURVEY
1816 South Oak Street,
Champaign, Illinois
61820 USA



# Organic Crops

*continued from front page*

frequently with our organic grower advisory board to choose specific crops in each rotation, develop management philosophies for each farming system, and carry out field operations appropriately within the context of organic certification. Crops grown to date are Roma tomato (high-intensity system) and food-grade soybean (medium-intensity system), 2003; broccoli/cabbage (high-intensity) and winter wheat (medium-intensity), 2004; and winter squash (high-intensity) and field corn (medium-intensity), 2005.

We have already noted some early trends or significant differences within a given season among the cropping intensity treatments and/or amendment sub-treatments. A few examples from 2004 illustrate these findings. Fungivorous nematode populations were stimulated by type of amendment application but were reduced by the level of system disturbance. Plant-parasitic nematodes were also reduced by system disturbance but were unaffected by amendment applications. Incidence of leaf rust on grasses in the low-intensity treatment (perennial pasture) was most severe in manure-amended sub-plots, but type of amendment did not influence insect pest populations in broccoli-cabbage plots. Density and diversity of ground-dwelling insect predators and seed-feeders were greatest in the low-intensity treatment.

For most of us, however, our most important data collections will be made *after* transition. We are following certification guidelines so that the field site can be certified for organic research at the conclusion of the transition period (2006). In 2006 and 2007, the same vegetable crops will be planted across all plots regardless of farming system history. This will allow us to evaluate how the transition schemes initiated in 2003 have affected soil fertility, crop productivity, weed communities, beneficial insects, and pathogen/insect pest problems.

**Acknowledgments:** Funding for this project is provided primarily by grant number 2003-51106-02086 from the Organic Transitions program of the U.S. Department of Agriculture's Cooperative State Research, Education, and Extension Service.

*Cathy Eastman, Edmond Zaborski, Jonathan Lundgren, and John Shaw, Center for Ecological Entomology; Michelle Wander, Darin Eastburn, John Masiunas, Leslie Cooperband, Deborah Cavanaugh-Grant, Dan Anderson, Carmen Ugarte, and Shin-Yi Lee, University of Illinois*

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ILLINOIS DEPARTMENT OF NATURAL RESOURCES

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No. 386

INSIDE





# 24 Hours: The 2005 Busey Woods BioBlitz

What brings more than 50 scientists together with interested amateurs and the general public for a 24-hour extravaganza to see how many species could be identified from a 59-acre urban natural area? The 2005 Busey Woods BioBlitz, which ran from noon on June 24 to noon the following day, was sponsored by the Urbana (Illinois) Park District and supported by a grant from the Illinois Department of Natural Resources. It featured many biologists on busman's holiday from their work at the Illinois Natural History Survey (INHS), and from various parts of the state. Armed with nets, binoculars, and other assorted gear, these scientists wrote down their observations, checked species off lists, examined samples of water and soil under a microscope, and generally looked everywhere they could think of in the quest for additions to the growing list of species identified during the blitz. Specialists spoke with the public, who were invited to learn about the biodiversity of this much loved park. The data collected were entered into a database called Mandala, which was originally created for a National Science Foundation PEET (Partnerships for Enhancing Expertise in Taxonomy) project dealing with specimen-based systematics research of a poorly known family of flies (Therevidae) that are not only present in Illinois, but found worldwide. The database was first used at the Allerton BioBlitz in 2001 where 1,949 species were identified from nearly 3,000 observations recorded during a 24-hour period in this 1,500-acre park near Monticello, Illinois.

*INHS researcher Tim Smith, with net, searches for fishes during the 2005 Busey Woods BioBlitz in Urbana. Volunteer Jim Hoyt follows with a collecting bucket.* Photo by Julie Miller, Urbana Park District

So why, in an area less than 4% of the size of Allerton Park, did scientists manage to find 1,327 species (in ~1,700 recorded observations), including a new state record for a planthopper, or nearly 68% of the total number of species identified at Allerton? Part of the answer goes to the root of why biodiversity studies are important and why so many specialists are needed to do this work. Biologists working during the blitz were under no illusion that they would identify all of the species to be found in those 59 acres, and in fact, no one knew how many species might be there, because no one had ever really looked in such detail. This was both an opportunity to share with the public the kind of work and tools that it takes to conduct a bioinventory of a site, and to take a snapshot of its biodiversity. To do a thorough bioinventory of an area, the work that many of these biologists are engaged in throughout the state of Illinois, takes more than the quick snapshot in time allocated for this bioblitz. Changes through the season, caused by differences in temperature and moisture will also account for variation through time. Bringing home the message about the importance of establishing baseline data for an area, being able to monitor changes in the biodiversity through time, and

*Continued on back page*

# Mapping Owned, Managed, or Leased Properties of the Illinois Department of Natural Resources

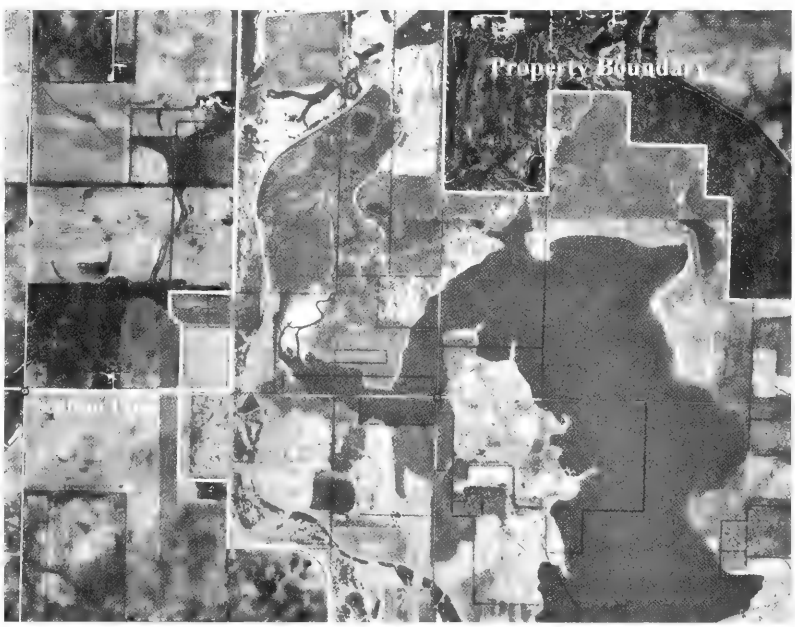
Development and enhancement of key data sets are vital to efficiently direct efforts to protect, conserve, and manage natural resources and to effectively evaluate the success of those efforts. In Illinois, over 90% of the land is privately owned. Illinois Department of Natural Resources (IDNR) lands provide a critical opportunity to directly protect, manage, sustain, and enhance the state's remaining natural lands and waters and the plants and animals they support. Comprehensive, reliable, and accessible information regarding the land holdings of IDNR (which total approximately 417,000 acres) is vital for planning, implementation, and assessment of the long-term conservation strategy for the state as outlined by the Illinois Wildlife Action Plan (formerly known as the Comprehensive Wildlife Conservation Plan).

The GIS staff at the Illinois Natural History Survey is developing a spatial database of locational data and descriptive information (e.g., ownership, funding source, management goals and activities, and restrictions) for conservation-related properties owned, managed, or leased (OMLP) by IDNR. Utilization of the OMLP database in a GIS environment allows access to descriptive tabular information in a single database, visual display of information on maps, and the capability to conduct spatial analyses with a variety of other databases (e.g., wildlife species distributions, areas of high biodiversity, land cover, surrounding land use, surrounding land ownership) and at a variety of scales, providing scientific and technological information to meet ecosystem-based management and protection goals.

The OMLP project was initiated in the fall of 2003. The OMLP geodatabase consists of property boundaries at the parcel level, with legal boundary descriptions obtained mainly from paper records from the Office of Realty and Environmental Planning at the IDNR office in Springfield. Each property requires a thorough research of files with extensive amounts of paper records for relevant information concerning parcel boundaries and conservation practices. Most properties consist of multiple parcels; some of the more complex properties have hundreds of parcels. A procedure for accurately and consistently digitizing each property has been developed using ESRI ArcGIS software. Metadata are being created for the GIS data layers using Federal Geographic Data Committee compliance standards as a guide. A quality assurance/quality control (QA/QC) methodology has been put into place to ensure that the data created meet the accuracy standards defined in the OMLP project data input methodology. To maximize its usefulness as an information and planning tool, the OMLP database has been designed for integration with other agency databases. This will facilitate coordinated conservation management activity efforts within IDNR.

The OMLP project is an on-going effort. The initial phase of the project focused on mapping properties purchased with federal or special funds (Habitat, Pheasant, Migratory Waterfowl Stamp, and Furbearer funds); subsequent phases will include additional IDNR properties such as state parks, state conservation areas, and state forests.

*Tari Tweddale, Center for Wildlife and Plant Ecology*




Completed OMLP property showing Shabbona Lake located in DeKalb County.

# New INHS Space Facilities

After 17 years of preliminary planning (primarily led by recently retired William Ruesink), and two major shifts in direction due to funding constraints, the Illinois Natural History Survey (INHS) is continuing its move out of the Natural Resources Building (NRB) at 607 Peabody Drive, to new facilities on the south campus adjacent to the recently developed University of Illinois Research Park. Since 2002 the east half of what is referred to as the I-Building (we're looking for a new name) at 1816 South Oak Street was leased and shared by INHS and the Illinois State Geological Survey. A total of $26.7 million was raised for the INHS move project. Project funds, now in one university account, came from a long-standing state appropriation, the University of Illinois, money allocated by the Illinois Department of Natural Resources from the sale of the old Burnham Hospital complex, and state initiative funds provided by the late Senator Stanley Weaver. About $20 million was made available for new INHS facilities, and about $6.7 million for renovation of vacated NRB space for use by the university. In 2004, project funds were used to purchase the entire I-Building. During 2005 the west side of the building was renovated (~ 20,000 nsf) and a move from NRB was completed in late November 2005. This new space accommodates most of the Office of the Chief, library, and most of the Center for Wildlife and Plant Ecology.

The I-Building is the new headquarters of the Illinois Natural History Survey.

The second phase of our move involves construction of a new building (~ 30,000 nsf). This is to be adjacent to the Natural Resources Studies Annex (1910 South Griffith Drive) which houses most of the survey's Champaign-based Center for Aquatic Ecology and Conservation. Both buildings will be very near the I-Building, thus providing better consolidation of our programs. The new building will be used to house the survey's biological collections and associated staff, as well as the UIUC biological collections. In addition, the new building will include wet laboratories for use by staff in the Center for Biodiversity and the Center for Wildlife and Plant Ecology. Design work for this project began in September 2005 and we anticipate that we might be able to move to this new facility in early 2008. Until then, the Center for Biodiversity and the biological collections will remain in NRB.


New Address: Illinois Natural History Survey
I-Building
1816 South Oak Street
Champaign, Illinois 61820

Looking to the future, we are hoping that someday Capital Development funds will become available for a much needed phase 3 building. This facility, adjacent to the above mentioned new building, would allow us to relocate our Insect Pathology Program, which remains isolated on north campus in the National Soybean Research Center. We would also relocate sections of programs currently housed in pole barns and other substandard facilities adjacent to the Annex and the I-Building. We would also like to provide staff much needed environmentally secure BL-3 laboratories for our research in medical entomology, insect pathology, wildlife disease, and other research areas where we are currently constrained. We can only remain hopeful that the state economy will improve to the point that our dreams can be realized.

*Ronald McGinley, Assistant Chief*

# Energy Impact of Compact Development vs. Sprawl (Urban Ecology III)

There are many valid social and economic reasons to favor compact development over "sprawl." Additionally, it is often claimed that living in compact neighborhoods requires significantly less energy than suburban or rural living. The usual image is that sprawl means more and longer auto commuting and more spacious housing, both major energy users. But because energy is required to produce and provide all consumer goods and services, one might be suspicious that this picture is too simple: what about those vacation trips to California or Italy?

Previously (Urban Ecology, Part II. *INHS Reports* No. 373:4. Autumn, 2002) we outlined the method of converting detailed household expenditure data (from the U.S. Bureau of Labor Statistics (BLS)) to energy requirements. We reported that in spite of the concern about other expenditures, four items related to sprawl comprise a major fraction of nationally averaged household energy impact. Updating the approach has reinforced this conclusion: for the year 2003 auto fuel (23%), residential fuel and electricity (39%), and purchase/maintenance of auto (6%) and housing (13%) add up to 81% of the total. This seems to argue for a large energy-saving potential for sprawl management.

But in spite of this result, we are finding that on average in America today, the rural energy intensity (energy divided by dollars) is only about 16% higher than urban. Figure 1 illustrates how this is determined. Points above the average graph of energy versus expenditures are more energy intensive (i.e., require more energy per dollar spent) than average, while points below are less energy intensive. The figure shows a trend towards lower intensity as the population of the living area increases from "outside urban area" to a city of more than 5 million inhabitants. This difference is significant, but not as large as compact ("smart") growth proponents have claimed. If it is correct, it is an example of the limits of efficiency as a solution to the energy requirements of growth. That efficiency improvements often are followed by an increase in consumption is known as Jevons' Paradox, and is exemplified by the equation I=PAT (Ecological Numeracy. *INHS Reports* No. 352:4. July-August, 1998).

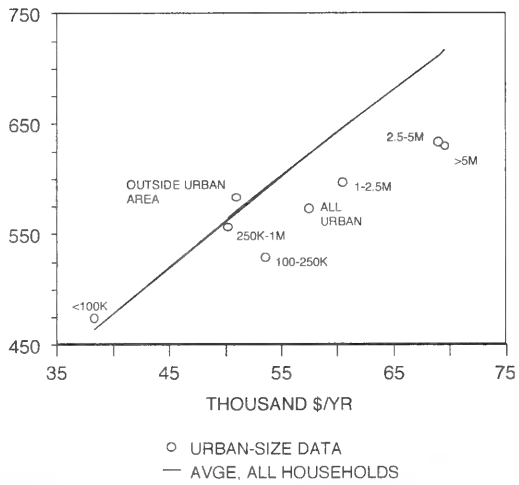



Figure 1. Average U.S. total household energy impact vs. expenditures, 2003. Only aggregated data sorted by population of urban area are available, resulting in the eight points shown. Points above the average line are more energy intensive than average; points below are less energy intensive.

How accurate is this result? There are many issues of method, data, and even of interpretation, which we are investigating, including a statistical analysis of the full BLS household consumption survey But we think the 15–20% size of "the effect" is reasonable for the following reasons:

1. Studies in Norway, Denmark, and Australia have found differences in the 12–14% range. They are highly developed countries and comparable to the U.S. Results for Brazil and India show smaller differences, though their data are less reliable.

2. In the U.S. auto (car, pickup truck, van, SUV, etc.) ownership (0.71 per capita) is already saturated. All of the eight household classes in Figure 1 have 1.7–1.9 autos per household except "outside urban area" (2.3) and ">5 million" (1.5). Except for exceptionally dense living, as in Manhattan, even urban life involves auto ownership only marginally different from suburban life.

3. We have accounted for all expenditures and hence covered the effect of "respending" money saved through less vehicle and residential use. In some cases the respending is as energy intensive as the original spending. For example, while public ground transport uses several times less energy per passenger mile than auto, it is comparable in energy per dollar spent. See the comparison below.

| Option | Energy intensity (1,000 Btu/$) |
|---|---|
| Auto, 25 mpg, total cost $045/mile. | 17 |
| Suburban bus, Portland, OR, 4 mpg, 10 passengers, 15 miles for $1.70 | 40 |
| Urban bus, Champaign, IL, 3 mpg, 10 passengers, 2 miles for $1.00 | 12 |

Consumer goods and services from a highly connected economy tend to be "blended" by integrated manufacture, transportation, and marketing...not to mention globalization. It is possible to design a lifestyle that reduces energy requirements, but if overall consumption measured in dollars/year is maintained or increased, we still find that one must be studiously careful about how that money is spent to avoid largely erasing the gains.

*Robert Herendeen, Center for Aquatic Ecology and Conservation; Md. Rumi Shammin and Michelle Hanson, UIUC*

# Insect Biodiversity Informatics

The Illinois Natural History Survey (INHS) Insect Collection houses approximately 6.5 million specimens collected over the course of 145 years. What these specimens represent is the biological history of the state of Illinois, with every specimen being a record of a particular species located at a particular place and at a particular time. Any single specimen can therefore be said to have three principal dimensions of data: the species name (taxonomy), where it was collected (place), and when it was collected (time). There are other dimensions, of course, such as the coloration or anatomical characteristics of the specimen, the identity of its host (if it is a parasite), what its behavior was at the time of capture, et cetera.

The most frequent users of the insect collection are systematists who study the diversity of insect forms within and between species to better understand and describe the biological diversity of our planet. Because the primary use of the collection is for taxonomic purposes, and because ascertaining the taxonomic dimension of a specimen is considerably more work than ascertaining its collection locality and date, the arrangement of the specimens is taxonomic. That is, the collection is arranged according to the insects' taxonomic hierarchy. For instance, all the beetles are together in the collection, and the families of beetles are themselves arranged alphabetically within that larger group.

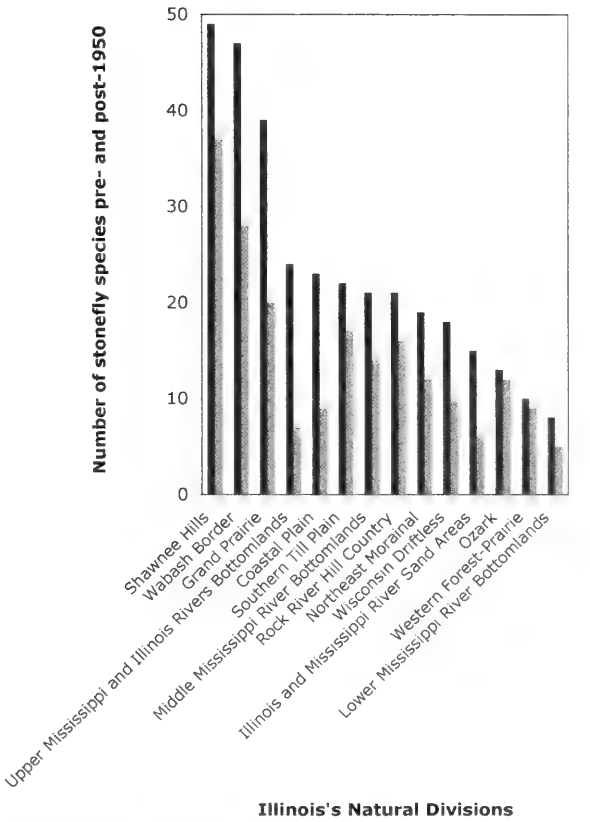
It is relatively easy to create a list of all the places a particular insect species was collected: just go to that part of the collection and look through the specimens. Creating a list of all the species collected at a particular place is much more problematic, however, as one would have to look through the entire collection; likewise if one wanted to create a list of the insects collected in Illinois in the 1940s.

In order to exploit all three key specimen dimensions, we need a method of easy data retrieval, that is, a computerized specimen database. Digitizing the three dimensions is relatively straightforward, if labor-intensive. Each individual specimen is removed from the collection, the data on the specimen's label are manually entered into the database, a unique number is assigned to the computer record, a corresponding label is put on the specimen, and the specimen is then returned to the collection.

Once the data are entered, any number of analyses can take place. Data from the INHS Insect Collection database have been used for stoneflies to uncover new Illinois records, to document range expansions and contractions, fundamental shifts in insect species assemblages, and to evaluate the relative biodiversity over time of various parts of Illinois. See the chart for an example of recent work by INHS entomologist R. Edward DeWalt.

With three major orders of aquatic insects fully databased, we are now digitizing the data associated with the Hymenoptera: ants, bees, and wasps that constitute approximately 300,000 specimens. Along with the actual specimen data, we will also research and assign latitude and longitude coordinates for all the collection localities in the United States. These geoposition data will allow for easy mapping of species distributions in time and space.

The insect order Hymenoptera includes many groups of economic importance: many parasitic wasps are control agents for insect pests of agriculture, bees are critical plant pollinators, and ants disperse plant seeds. Over 100 species of ants in the United States are non-native, and two of them, the Argentine and red imported fire ants, alone cost billions annually in damage and control efforts. Other Hymenoptera have similar economic significance.




The number of species of stoneflies in the INHS Insect Collection collected before 1950 (black bars) and after 1950 (grey bars), in Illinois's 14 natural biological divisions. Note that every natural division has lost some of its stonefly fauna.

The data gathered by this three-year project will provide valuable tools for documenting species declines or local extinctions, the historical presence of particular species, changes in species distribution, range expansion of invasive species, ecological restoration, assessments of biodiversity, and conservation. The INHS bumblebee collection is particularly strong in its historical documentation and may, with new collecting statewide, provide interesting insights into the changes that have occurred in that fauna over time.

*Colin Favret, Center for Biodiversity*

*Species Spotlight*

# Hellbender

Susan Post

The hellbender, *Cryptobranchus alleganiensis*. Photo from INHS Manual 8: Field Guide to Amphibians and Reptiles of Illinois

In a few Illinois streams a large, cryptically colored salamander can be found—the hellbender, *Cryptobranchus alleganiensis*. Hellbenders are the largest salamanders in North America and the third largest in the world. Adults range in length from 11 to 29 inches and may weigh four to five pounds. They are fully aquatic and cannot live out of water.

Hellbenders have wide, flat heads with tiny lidless eyes and paddlelike tails. These salamanders have no external gills, instead they have folds of skin which help them take in oxygen from the water. These folds cover their bodies and their short, thick legs. While their bellies are usually only one color—yellowish-brown—the rest of their bodies are a combination of browns or grayish browns with dark blotches. During the breeding season hellbenders may have an overall reddish brown color.

Illinois Natural History Survey herpetologist Phil Smith described hellbenders as, "ugly in appearance and unpleasant to handle because of their extreme sliminess." This slime makes them very hard to catch and handle. Scientists think that the skin secretions keep the hellbenders free from infections, protect against predators, and decrease the friction of fast flowing water.

Hellbenders are found in the Appalachian and Ozark Mountain regions, from southern New York state to northern Georgia and west to Missouri. They have been found in southern and southeastern Illinois. They live in cool, clear streams with moderate to fast currents. The water is usually one to three feet deep and is a mix of faster flowing rapids and slower runs and pools. The rocky riffles help oxygenate the water. Large, flat rocks or bedrock with openings in shallow water are also important, as the hellbenders use these for shelter. Keeping their habitat protected from pollution, excessive siltation, and other degradations is key for hellbender survival.

Hellbenders are nocturnal, secretive, and seldom observed. They will walk along stream bottoms but most of their time is spent hiding under large, flat rocks. As water flows over their bodies, oxygen is taken up by tiny blood vessels in their skin and carbon dioxide is released. Hellbenders have lungs and are capable of gulping air from the surface; however, their lungs are mainly used for buoyancy.

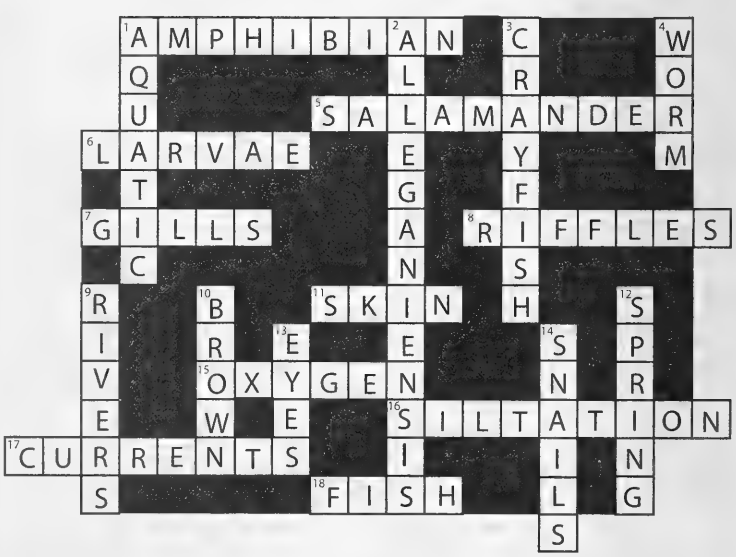
They will eat a variety of aquatic prey, such as small fish and insects; yet, 90% of their diet consists of crayfish.

Courtship and breeding take place during late summer or early autumn. During this time hellbenders increase their activity and may actually be seen walking around on the bottoms of streams. Females will reach breeding age at seven or eight years of age and may breed only every second or third year. Males breed at a younger age. In the fall the males will excavate cavities (nest sites) under large rocks. The female will lay her eggs in a long strand (similar to a strand of beads) in a cluster in the nest site. The male will then come and fertilize the eggs externally, much like a fish. Once the female has laid her eggs, the male forces her out of the nest and he stays and guards the eggs, protecting them from other hellbenders that would eat them. The eggs will swell to ping-pong ball size and hatch in four to six weeks. The newly hatched larvae are less than one inch in length. The larvae have streamlined bodies, short gills, and low tail fins. Once they begin to eat small aquatic invertebrates, the larvae will turn dark brown or black. By their second year the larvae are four to five inches in length and have lost their gills. The larvae spend most of their time hiding in stream gravel niches. Hellbenders can live for 30 to 35 years.

Hellbenders have a variety of nicknames based on appearance and/or location. These include mud cat, walking catfish, Allegany alligator, snot-otter, mud devil, and mountain alligator. The common name of hellbender is thought to have originated with early settlers who upon seeing the organism's odd look, thought it was a creature from hell and bent on returning.

## The Naturalist's Apprentice Teachers' Page

Answers for Crossword Puzzle on next page



*The Naturalist's Apprentice*

# Hellbender Crossword Puzzle

Carolyn Nixon

**Across**

1. Hellbenders are a type of this animal group. It also includes frogs and toads. The word means an animal that can live both in water and on land.

5. Hellbenders are members of #1 across that are long and slender, and have tails and legs as adults.

6. Young hellbenders are called _____.

7. Young hellbenders breathe with these organs, but lose them before they become adults.

8. Areas of streams where water churns and splashes as it flows over rocks are called _____. Hellbenders often live in streams that have this type of habitat.

11. Adult hellbenders breathe through this soft, slimy, wrinkled body covering.

15. Hellbenders only live in streams that have a lot of this important air component dissolved in them.

16. Fine sediment that is deposited on the bottom of a stream and often covering up the rocks is called _____. Streams that have a lot of it no longer have hellbenders.

17. The flowing movements of water in a stream are _____. Hellbenders need streams with fast ones.

18. Hellbenders sometimes eat the small examples of these swimming animals that have scales and spines.

**Down**

1. _____ animals live in water. Hellbenders are this for their entire lives.

2. Cryptobranchus _____.

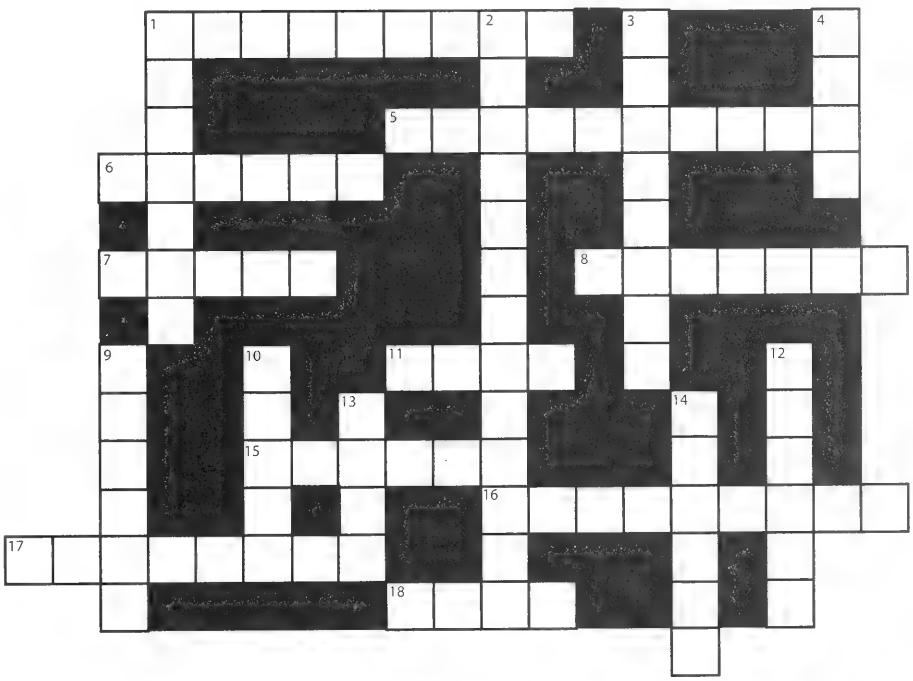
3. These lobsterlike animals are the main food of hellbenders.

4. A hellbender will often eat one of these long, slender, soft animals. Some anglers will put one on a hook and use them as bait to catch #18 across.

9. Large streams, where hellbenders often live, are called _____.

10. The main color of a hellbender is _____.

12. The preferred habitat of the hellbender is _____-fed streams.



13. These organs, used for sight, are very small on hellbenders.

14. Hellbenders sometimes eat these mollusks that have coiled shells.

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# BioBlitz

*continued from front page*

having specialists able to reliably track these changes, are important to enabling public understanding of the work being done by INHS scientists around the state.

While the numbers of scientists working during the Allerton and Busey Woods BioBlitzes were somewhat comparable, the mix of specialists was different. It is likely that the comparatively large difference between the numbers of beetles identified at Allerton (275) vs. Busey Woods (96), was due at least in part to a missing specialist. However, the difference in the number of conifers (Allerton, 10; Busey Woods, 1) was more likely due to decreased diversity reflective of the smaller area covered by the 2005 blitz than a lack of qualified botanists. Interestingly, the numbers of higher plants identified, although fewer at Busey Woods (78 monocots; 300 dicots) than at Allerton (122 monocots; 392 dicots) were more indicative of the difference in the percentage of the total number of species identified, so less likely to have been influenced by changes in botanical expertise or interests of the scientists participating in the blitzes. However, such gross groupings presented here say little about the true diversity in these groups.

Add up all of the species of mammals (12), birds (54), fish (30), mollusks (11), reptiles (1), and amphibians (4), identified during the Busey Woods BioBlitz and the total (112) does not exceed the number of species of bees, ants, and wasps (132), butterflies and moths (156), or plant and true bugs (123) identified from the megadiverse insect groups. However with the insect groups, as well as many of the fungi, bacteria, and lower plants, identifications to species are difficult even for specialists, who in the limited time of a bioblitz must often content themselves to distinguishing morphospecies, or groups of organisms with enough characters in common to be thought of as separate species, but for whom no name may be definitively put.

This 24-hour demonstration in a confined area gives a hint of the challenge facing us if we ever hope to document and begin to understand the impacts of the changes we make to our landscape, not just in 59 acres, but around the planet.

*Gail E. Kampmeier, Center for Ecological Entomology*

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ILLINOIS NATURAL HISTORY SURVEY Reports

Spring 2006
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INSIDE



# Chicago Wilderness Celebrates 10 Years of Cooperative Conservation

About 10 years ago, representatives of a handful of groups, including the Illinois Natural History Survey (INHS), met at Chicago's Field Museum to discuss how they might cooperate to conserve biodiversity in the Chicago area. Soon their number grew to 34 forward-thinking organizations. In April 1996 they formed Chicago Wilderness, a consortium dedicated to protect, restore, study, and manage the ecosystems of the Chicago region to help preserve global biodiversity and enrich local residents' quality of life. Now more than 180 members strong, Chicago Wilderness is celebrating its 10th anniversary.

*Blanding's turtle, an Illinois-threatened species now found primarily in the Chicago area. INHS staff are studying this species' biology and status.* Photo by Mike Dreslik, INHS

"Chicago Wilderness" sounds like an oxymoron; after all, more than 9 million people call this region home. Yet despite its intense urbanization and sprawling suburbs, the Chicago metropolitan area has significant natural resources. Stretching from southeastern Wisconsin through northeastern Illinois and into northwestern Indiana, the region holds more than 225,000 acres of protected lands and waters, home to thousands of native plant and animal species, many of them threatened or endangered. Some of the natural communities they form are rare enough to be of global conservation significance. For example, many of the best remaining examples of tallgrass prairie and oak savanna, both of which have almost disappeared from both the state and region, can be found in the Chicago area. The region is also a crucial stopping point for birds migrating along the Lake Michigan Flyway and provides breeding habitat for many grassland, wetland, and forest birds.

Independently and in partnership, Chicago Wilderness members work to restore the health of local natural areas using land management tools such as controlled burns and invasive species removal, and monitor the status of the region's plants and animals using both professional scientists and trained volunteer citizen scientists. Consortium members conduct research to understand the biology of the region's organisms and the impacts of habitat changes upon them. They train school teachers to incorporate the concept of biodiversity into their classroom curricula. Members of the consortium also work with elected officials and land-use planners to facilitate sustainable development.

Chicago Wilderness has achieved many notable successes. These include the publication of the *Biodiversity Recovery*

*Continued on back page*

*Yellow-headed Blackbird banded during INHS research. In Illinois, this species breeds only in the Chicago area.* Photo by Mike Ward, INHS.

# Mallows in Illinois

A mallow can be defined as any member of the genus *Malva*, whose common name is Mallow, or it can be more broadly defined as any member of the plant family Malvaceae, generally known as the Mallow Family.

Two of the 26 Illinois mallows have been listed as state-endangered, the Kankakee mallow (*Iliamna remota*) and the False mallow (*Malvastrum hispidum*). The Kankakee mallow is generally well-known because native individuals are restricted to one small limestone island in the Kankakee River in Kankakee State Park and nowhere else in the world. The False mallow is a small rather inconspicuous annual that grows in very shallow soil on level dolomite or limestone bedrock within dolomite prairies. The largest remnant populations today are in small areas around the growing industrial and refinery complexes of Channahon in Will County.

Five other native Illinois mallows appear to be in decline as well. The Poppy mallow (or Hollyhock mallow, *Callirhoe alcaeoides*) of gravelly prairies may already be extinct in Illinois, though it was once known in six counties. The related Triangle-leaved poppy mallow (*Callirhoe triangulata*) is disappearing fast. Its survival in Illinois appears to depend upon its protection in a few remnant sand prairies. Another mallow may also be extinct in Illinois now, namely, Elliott's sida (*Sida elliottii*). It has been found only in Alexander County. The Northern swamp hibiscus (*Hibiscus palustris*) appears to survive in a single native population in a salty swamp near Starved Rock in La Salle County, though an introduced population appears to occur along a salty roadside near old coal wastes in Will County. The Glade mallow (*Napaea dioica*) is having better luck—Illinois appears to have most of the larger surviving populations of this striking perennial, once considered for inclusion in the federal endangered plant list. This plant, the only member of its genus, is unique among Illinois mallows because individuals are either male or female (as in most animals) and so only half of the plants can produce seeds.

*"Girl with Hollyhocks" by Victorian painter James Hamilton shows this mallow has been popular in gardens for a long time.*

The remaining four native mallows in Illinois appear to be doing well here—these include three swamp, floodplain, or pond margin species often called Rose mallows or, simply, Wild hibiscus (*Hibiscus laevis, H. lasiocarpos*, and *H. moscheutos*) and one annual species often considered to be an introduced weed, the Prickly sida (*Sida spinosa*). The wild hibiscus species have showy white to pink flowers with a rose-red center, but each flower lasts only a single day. These successful species appear to tolerate a lot of environmental disturbance and change.

Ten non-native mallows were brought to Illinois either on purpose or by accident by settlers. These include the economically important cotton (*Gossypium hirsutum*); this may become a major crop in Illinois as global warming increases!

*This mallow of the genus* Hibiscus *was painted by Mary Vaux Walcott, who made over 400 paintings of North American plants in the early 20th Century.*

[see IL Nat. Hist. Surv. Reports No. 374, p. 2]), and the lesser economic plant Okra (*Abelmoschus esculentus*), as well as the garden ornamentals Hollyhock (*Alcea rosea*), Rose-of-Sharon (*Hibiscus syriacus*), Annual poppy-mallow (*Callirhoe digitata*), and Vervain, Musk, and High mallows (*Malva alcea*, *M. moschata*, and *M. sylvestris*). The Curly mallow (*Malva verticillata* var. *crispa*) is a rarely escaped vegetable whose leaves can be used as greens. The introduced Texas wine-cup (*Callirhoe involucrata*) is found today primarily in a handful of cemeteries where it was introduced from the southwestern states many years ago.

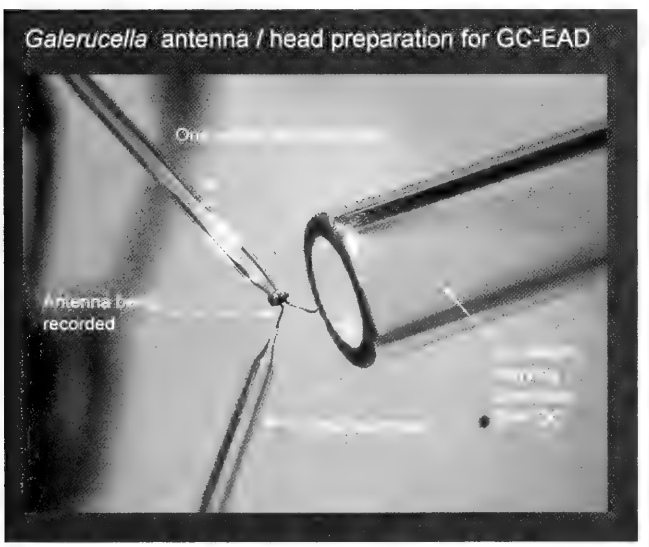
The final five Illinois mallows are accidently introduced weeds that generally spread with crop seeds. One of these, *Abutilon theophrasti*, is usually considered to be a serious pest, and is called, variously, Velvet-leaf, Button-weed, or Butter-print. Another field weed in the family is *Hibiscus trionum*, the Flower-of-an-hour, a far less noxious weed, and our only annual member of the genus. The seeds of these two weeds often occur as contaminants in crop seeds, and so

*Continued on page 5*

# Male-produced Aggregation Pheromone in *Galerucella* Beetles

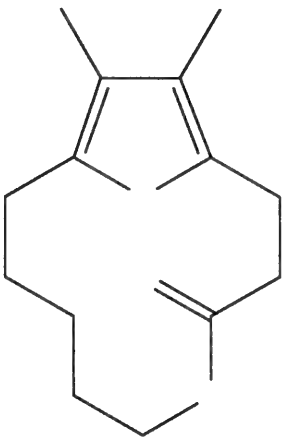
Illinois researchers continue to learn more about biological control agents for the invasive weed, purple loosestrife. This beautiful but aggressive and prolific plant, originally from Eurasia, became firmly established in Illinois wetlands in the mid 1800s and has caused serious ecological damage by displacing native flora. In 1994, two species of leaf-feeding beetles from Europe, *Galerucella calmariensis* and *G. pusilla*, were introduced in northern Illinois in an effort to bring the weed under control by biological means. Since then, *Galerucella* beetles have nearly eliminated purple loosestrife from some infested wetlands, but less spectacular results in others have prompted additional research into the biology of the beetles. Hopefully, insights obtained will lead to practical improvements in the biocontrol program.

In this vein, the study of *Galerucella* pheromones began in 2002 as a collaborative effort between the Illinois Natural History Survey (INHS) and the USDA-ARS National Center for Agricultural Utilization Research (NCAUR) in Peoria. We believe pheromones—the natural chemicals that the beetles use to attract mates—can become useful tools in biocontrol programs. Traps baited with synthetic pheromone could efficiently provide information about beetle dispersal, overwintering survival, and the seasonal timing of adult activity. Because of their potency, pheromones would be particularly useful in sparse populations, where monitoring by traditional methods is difficult.




Using beetles supplied by INHS, preliminary experiments at NCAUR indicated that males of *G. calmariensis* do indeed emit a pheromone and that both males and females can sense it. This pattern was consistent with a male-produced aggregation pheromone, a common circumstance in the Coleoptera. Briefly, the research procedure was to capture chemicals from the air around beetles feeding on host foliage, a technique adapted for *Galerucella* by NCAUR. Collections from males and females were then compared by gas chromatography, coupled with either mass spectrometry (GC-MS) or electroantennographic detection (GC-EAD). In GC-EAD, performed by NCAUR, beetle antennae were attached to a sensitive electronic amplifier (see illustration below) and then exposed to compounds as they emerged from the GC column. GC-EAD allows recognition of chemicals that are particularly well sensed by insects (as a pheromone would be), even within complex mixtures. The existence of a potent, male-specific compound was demonstrated quickly, but the amount emitted was miniscule and the mass spectrum and other initial data suggested that the structure was new and relatively complicated.

A technique called nuclear magnetic resonance (NMR) spectrometry would be required to solve the structure. NMR does not harm the sample, but a relatively large amount of material is needed. After processing over 1,000 pheromone collections during three years, a pure sample of 17 micrograms (millionths of a gram) was accumulated, enough to attempt NMR analysis. Although researchers made significant progress with this sample, some key information was still not within reach of the NCAUR instrument. A collaborator at Pfizer Global Manufacturing in Kalamazoo, Michigan, finally obtained the definitive NMR spectra on an instrument that was specially equipped for micro-scale analysis. The pheromone has a novel furan-lactone ring system (see illustration above) and is unlike any previously identified pheromone. Interestingly, *G. pusilla* produces exactly the same compound. A laboratory synthesis, done at NCAUR early in 2005, confirmed the structure and provided material for fieldwork.



Galerucella *pheromone molecular structure.*

The first field tests were conducted during May 2005 in purple-loosestrife-infested wetlands near Chicago that were known by INHS entomologists to have *Galerucella* populations. Yellow sticky traps baited with the compound attracted over five times more males and females of both species than control traps, which clearly verified the activity of the synthetic aggregation pheromone. The information will be published in the 2006 volume of the *Journal of Chemical Ecology*. Research continues on pheromone biology and on the development of pheromone-based tools.

*Robert J. Bartelt, Research Entomologist, USDA-ARS-NCAUR*

# Reference Stream Conditions in the Illinois Grand Prairie Natural Division

The Critical Trends Assessment Program (CTAP) has been sampling Illinois streams since 1997. A major finding was that channelization (straightening) of streams was the single-most important factor affecting stream condition. However, do we really know how badly streams are degraded? To answer this we have to sample regional reference streams, which become models of the highest biotic potential against which we compare results of randomized sampling.

Fifty potential stream reaches of varied size were evaluated during 2004–2005 to determine their suitability as reference, with only 17 reaches making the cut. These stream reaches were evaluated with CTAP protocols (see methods used at http://ctap.inhs.uiuc.edu), using Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa richness, the Hilsenhoff Biotic Index (HBI, a weighted tolerance based index), and a 12-parameter Habitat Quality Index (HQI) as metrics of condition. EPT and HQI increase with increasing stream condition, while HBI, which ranges from 0–10, increases in value with decreasing stream condition. The randomized reaches were partitioned by channel form (channelized vs. meandering), while all reference reaches had meandering channels. To look for size effects, randomized and reference reaches were partitioned as small (≤10 m) or large (> 10 m wide).

Reference reaches scored better than randomized ones for most metrics. Dramatic, significant differences for EPT richness occurred across channels (Fig. 1). Stream size had less of an influence on EPT richness, with no significant differences across small and large reference streams, but significant differences across large and small randomized streams.

HBI had lower (better) average scores in reference streams, but the difference was not significant. Degradation has occurred here over a very long time, causing extirpation or severe range loss of the most sensitive species. INHS museum collections prove these species were present and in many cases even abundant as late as the 1940s. A published account of such losses for stoneflies is available for download from the publications page of the CTAP Web site.

HQI displayed a more complex relationship ( Fig. 2), with small channelized reaches scoring poorly and large, meandering and reference streams of both sizes having statistically insignificant differences. Small, meandering streams formed a third distinct grouping.

Because reference and random sites were statistically different, it is possible to construct an empirical rating system from the reference data. Differences were mostly due to channel type (channelized vs. meandering), so stream size was ignored. Reference EPT, HBI, and HQI means and one, two, and three standard deviations out created categories for excellent, good, fair, and poor quality. Metric values for randomized reaches were fitted into these scales. Randomized reaches was given integer values of 1 (excellent), 2 (good), 3 (fair), or 4 (poor) for each metric. An Overall Score was calculated across the metrics using the following (0.4EPT) + (0.2 HBI) + (0.4HQI) and qualitative ratings were assigned using the integer scale above. Note that HBI was weighted lower than the other metrics due to its invariant nature. Overall qualitative ratings were assigned to the reach using the integer scale above.

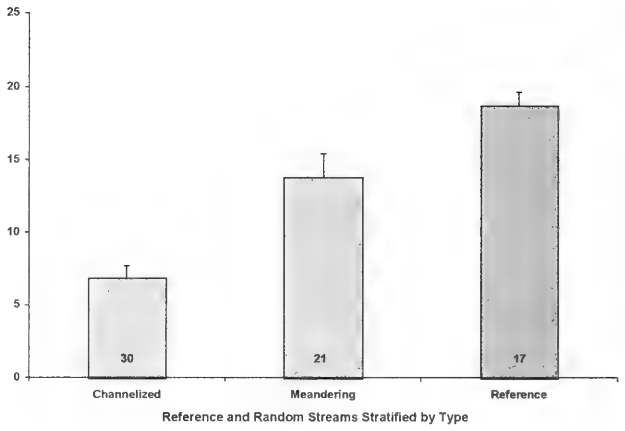



Figure 1.

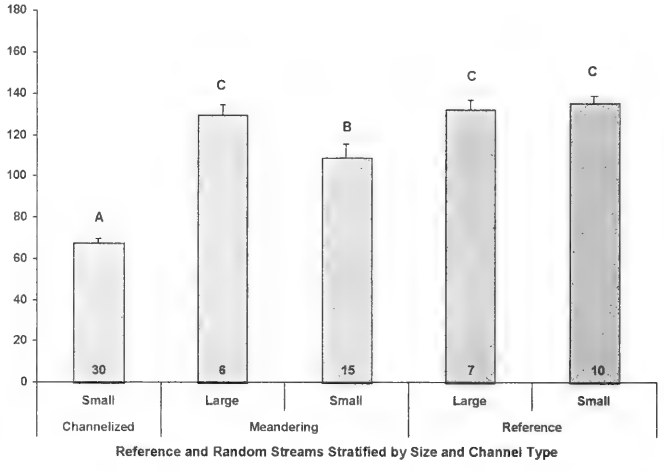



Figure 2.

The vast majority of streams in the Grand Prairie were in Poor and Fair condition. Less than 22% of streams in the region can be classified as of Excellent or Good quality. Given this distribution, it is apparent that Illinois is not meeting the stated goals of the Clean Water Act. Some practices that could yield dramatic improvements include the reduction of the degree of channelization, prevention of additional channelization, creation of wetlands to dampen flood events and degrade nutrients, and addition of habitat structures that provide refuge from the scouring effects of floods. Less frequent and less extensive maintenance of channelized streams would save tax payers money and would result in better quality than occurs in frequently cleaned ones.

*Dr. R. Edward DeWalt, Center for Biodiversity and Brandi Sangunett, Federal Energy Regulatory Commission*

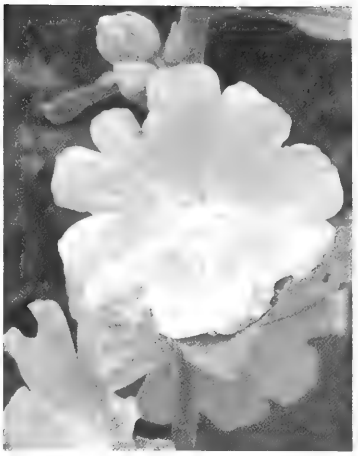
## Mallows

*continued from page 2*

they have been spread widely. The other introduced mallows are less serious weeds, and include Anoda (*Anoda cristata*—spreading from the south, often with rice cultivation), the Common mallow (*Malva neglecta*—in essentially every county in farmyards and disturbed moist dooryards), and the Dwarf mallow (*Malva pusilla* [= *M. rotundifolia*]—limited to northern Illinois, and looking much like the Common mallow). The last two are sometimes called cheeses, because the young fruit looks like a tiny wheel of cheese, and it is edible.

*Steve Hill, Center for Wildlife and Plant Ecology*

*The Kankakee mallow* (Iliamna remota) *is one of two state-endangered mallows in Illinois.* Photo by Steve Hill, INHS



*A close-up of a hollyhock flower.* Photo by Steve Hill, INHS

# Slowing the Invasion of Exotic Plants in Illinois

Any animal or plant that is not native to any part of Illinois and not a component of the flora and fauna at the time of European settlement is an exotic species. Exotic species that become established and replace native species are known as invasive species.

Exotic plants are introduced into new areas in a myriad of ways. The seeds of some plants can pass through the digestive systems of many animals without being damaged and then become deposited in new locations upon defecation. Some seeds are widely scattered by wind. Many smaller seeds, such as garlic mustard, are carried in the fur of raccoons, dogs, deer, and other animals and drop off as the animals move from one location to another. Others, such as leafy spurge and teasel seeds, collect on roadside mowers only to fall off as the mowers move along the road. Humans trim plants growing in their yards and gardens without thinking about proper disposal of the still-living cuttings, which are then dumped into an area where they take root. Kudzu, honeysuckles, periwinkle, English ivy and Chinese yam are just a few examples of plants that have invaded new areas in this manner.

Invasive species encroach and replace native flora in a variety of ways. Some invasive species, like buckthorn and Norway maple, block needed sunlight making it impossible for many of the native species to survive. Chinese bittersweet and porcelain berry grow to the tops of the tallest trees in the forest creating a dense smothering foliage and the weight of the vines will eventually pull the trees down. Some invasive species will compete more successfully than the native flora for water, minerals, and other necessary nutrients for survival. Some plants like the Chinese tree of heaven produce toxins that inhibit the growth of other plants nearby.

There are several ways for landowners to prevent invasive plants from spreading out of their yards:

- Make sure plants are not invasive in Illinois before buying seeds or plants. Even plants native to another part of the United States can be invasive in Illinois.
- Be wary of any plant that produces large amounts of wind-borne seeds or provides berries for wildlife which might spread the seeds to other areas.
- Landowners should exercise care when using plants that tend to shade out neighboring plants and/or spread quickly by runners, underground roots, or cuttings.
- Be very careful when buying or planting commercial mixtures of seeds as some of the seeds in the mixture may be both exotic and invasive.
- Avoid planting anything in your yard or garden that might spread into a nearby park, natural area, or open area.
- Remove all invasive species you already have growing in your yard.
- Do not dispose of unwanted plants or cuttings in nearby parks, natural areas, open areas, vacant lots, etc.
- Never dispose of unwanted aquarium plants or yard pool plants by throwing them into nearby rivers, lakes, or ponds.

Because the estimated worldwide devaluation of natural resources and cost of combating exotic invasives are more than $4 billion annually, it is necessary to act both globally and locally to successfully fight this problem.

To confront the spread of invasive plant species on a statewide level, the Illinois Invasive Plant Species Board was recently established. This board is composed of seven members from the green industry (managers of greenhouses and nurseries and landscapers) and seven members involved with restoration and preservation of natural areas. The board will establish a list of recommended native plants for landscaping along with a list of nurseries offering native species for sale. This cooperation of the commercial interests with restoration and preservation efforts is essential in our war against invasive plant species.

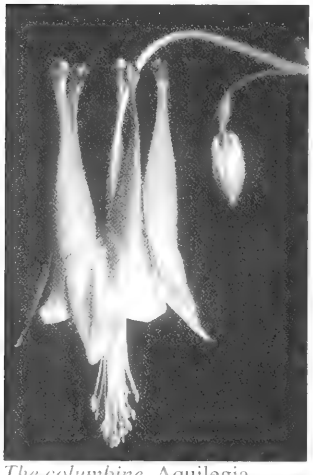
With the combined efforts of private citizens, governmental agencies, and green industry firms, we should be able stem the tide of exotic plant invaders flooding our state. And, with a little luck and hard work, we shall limit the spread of invasives that are already here.

*Ben Dolbeare, Center for Aquatic Ecology and Conservation*

*Species Spotlight*

# Columbine

Susan Post



*The columbine,* Aquilegia canadensis. Photo by Michael Jeffords, INHS Office of the Chief

"Our columbine is at all times and in all places one of the most exquisitely beautiful flowers."

John Burroughs

Columbine is the mountain goat of plants, seeking out cracks and crevices in rocks and often dangling precipitously from these high places like a tethered mountain climber. In the 1940s. North American naturalists once ranked columbine as the seventh most popular native wildflower. Columbine, *Aquilegia canadensis*, occurs throughout the eastern half of the United States from Maine to Minnesota south to Florida and Texas. In Illinois it is occasional to common throughout the state.

Columbine occurs in a variety of woodland habitats, but it is usually found in rocky woods. It seems to prefer rocky slopes, outcroppings, and ledges where the soil is scanty and limy (ph from 5 to 7.5). It is not unusual to find a clump of columbine growing in a handful of soil in a pocket on a huge boulder. Its flowers dangle on a thin stem.

Columbine is a perennial related to the buttercups, a member of the plant family Ranunculaceae. From a basal tuft of lobed, gray-green leaves, a tall, fibrous flower stem rises. The erect, branched stem can be up to 1 meter tall. Thin leaflets that are lobed, ovate, and green above and pale beneath are grouped along the stem. The upper leaves are three-parted.

Columbine blooms in Illinois from April to July. The flowers are scarlet, brightened by translucence and complemented by a yellow interior. They can be 5 cm long. The plant has five petals and five sepals, both colored alike. The petals are prolonged backwards into hollow spurs or tubes, which contain nectar deep inside. Hummingbirds easily sip the nectar from the flowers and in doing so pollinate them. Some bees and wasps will cheat the system by nibbling through the nectar end of the spur. Columbine fruits are cylindrical pods that open along the inner side, exposing two rows of smooth seeds. The buds and flowers of the plant hang inverted, whereas the fruit is erect.

The word columbine comes from the Latin *columba* and means dovelike, referring to the flowers, which appeared as a circle of doves to some people. The plant's long spurs are the heads and shoulders of the birds while the petals are the bird's wings. The genus name comes from *Aquila*, which means the eagle, referring to the flower spurs' resemblance to eagle talons. It could also refer to *Aqua* meaning water and *lego,* to collect, referring to the nectar holding spurs.

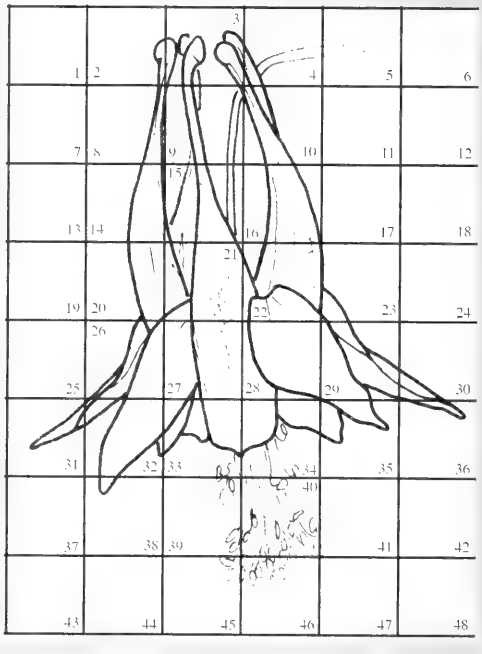
Common names are varied and include rock bells (as the flowers are bell-shaped and the plants do thrive in rocky soil), rock lily, bells, meeting houses, cluckies, and Jack-in-trousers. Pioneer children would call the flowers honeysuckle, as they could bite off the tubes for the nectar inside.

Whatever you decide to call columbine, the discovery of one on spring walks is a delightful surprise. Maybe even the words of Ralph Waldo Emerson will come to mind, " A woodland walk, a quest for river-grapes, a mocking thrush, a wild rose or rock-living columbine, salve my worst wounds."

*Columbine drawing that appeared in INHS Manual 1*—Fieldbook of Illinois Wild Flowers *in 1936.*

## The Naturalist's Apprentice Teachers' Page

Answer to the mystery picture on proceeding page: the blossom of a columbine. To color the pictures, you will need red, yellow, and green colored pencils.



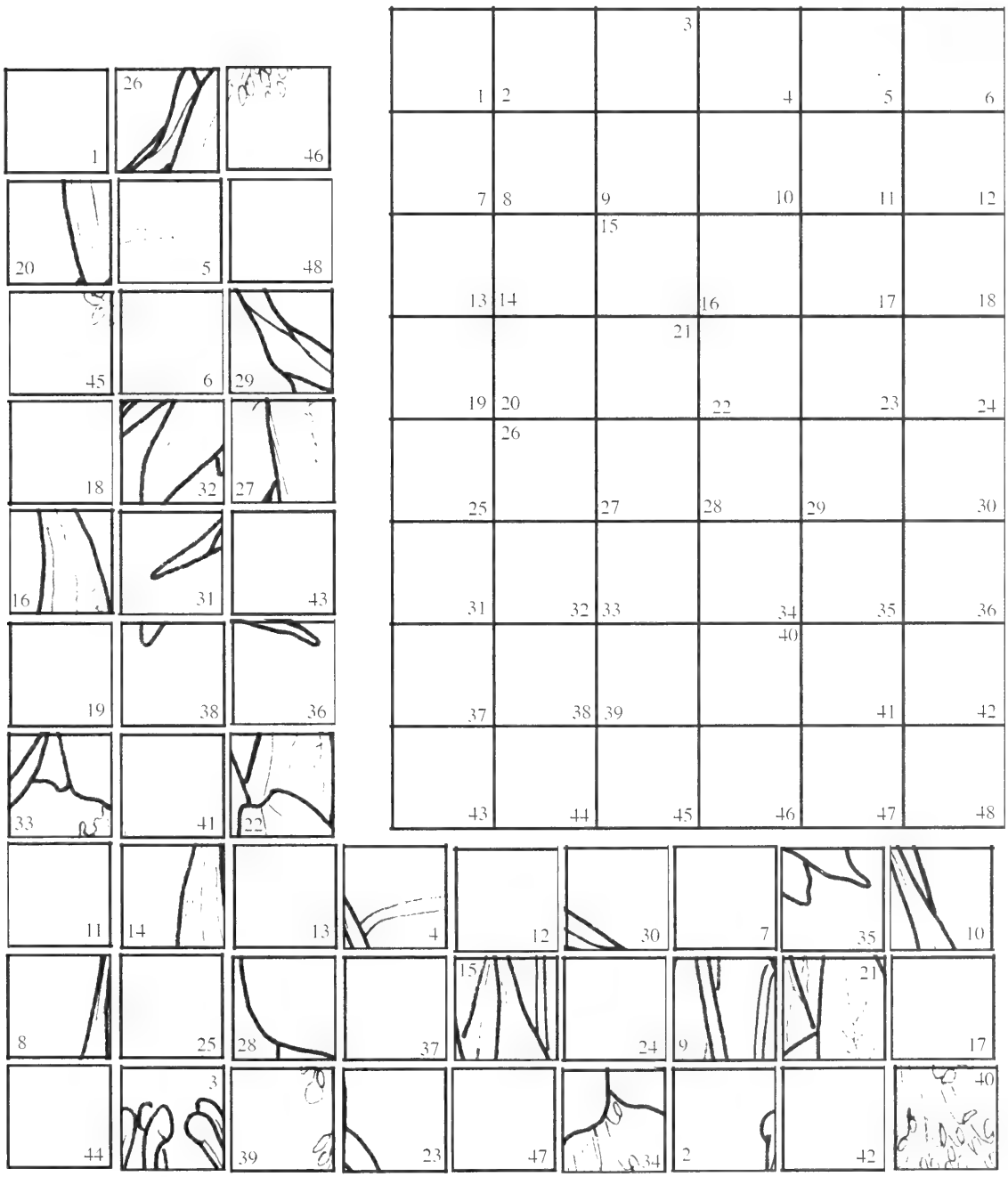
*The Naturalist's Apprentice*

# Draw the Mystery Picture

Carolyn Nixon

Draw the Mystery Picture

Below is a grid with squares numbered from 1 to 48. To the left and below the grid, there are 48 numbered squares, most of which have lines or shapes drawn in them. The lines are actually the sketch of a plant or an animal that has been cut up and scrambled to hide its identity. To reveal the hidden picture, carefully copy the lines from each of the scrambled squares into the square on the grid that has the same number. Once you have completed the drawing and identified the organism, you can color the picture with colored pencils.



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61820 USA



# Chicago Wilderness

*continued from front page*

*Plan*, an award-winning regional plan that serves as a blueprint for restoring and sustaining local biodiversity. The consortium is also an international model for collaborative conservation in an urban environment, and members are regularly invited to share the secrets of their collaborative success with other groups around the world.

From the outset, INHS has been an active supporter and member of Chicago Wilderness. We have continuously served on the consortium's steering committee. We also have been active in the research and educational programs, both by participating in the Science, Natural Resources Management, and Education teams and by carrying out projects in the region, many of them with financial support from the consortium or its members. Examples include studying bird responses to habitat restoration, investigating methods for improving fish habitat and controlling invasive aquatic species, and educating teachers and school children about biological control of purple loosestrife and the restoration of wetland biodiversity. We have been especially active in the biologically significant but highly degraded Calumet area, inventorying the insects and other organisms and tracing the movement of contaminants to wildlife in the area. Currently we are collaborating with other Chicago Wilderness members to develop a network linking volunteers, scientists, and land managers to detect and control newly arriving invasive species before they get established. We are also investigating the ecology of the threatened Blanding's turtle and analyzing long-term data on wetland bird populations. Recently we began overseeing the development of a program to monitor biodiversity throughout the Chicago region to assess the consortium's effectiveness and guide its future efforts.

The INHS is proud to be an active member of Chicago Wilderness, and looks forward to working with its organizational partners and others to continue to protect, restore, study, and manage the region's natural heritage.

*Geoffrey A. Levin, Center for Biodiversity and David L. Thomas, Chief, Illinois Natural History Survey*

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ILLINOIS NATURAL HISTORY SURVEY Reports

Summer 2006
No. 388

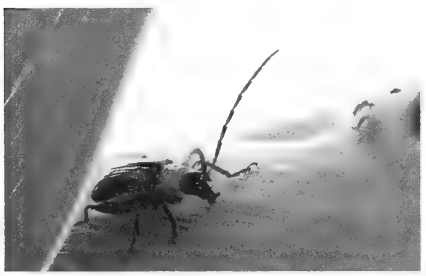
INSIDE



# Tracking Movement of Mate-seeking WCR Males between Refuges and Transgenic Corn

*Pair of western corn rootworms (WCR) beetles mating on a corn leaf.* Photo by Joe Spencer, INHS Center for Ecological Entomology

A black and yellow beetle emerges from the base of a corn leaf and climbs up the edge until it stops where the leaf blade begins to bend downward. It's early July in east-central Illinois and the beetle, an male western corn rootworm (WCR), is feeding on corn pollen that has accumulated at the base of the leaf. As he rests, his antennae alternately move up and down, slowly sampling the air for any drifting signals from nearby females. After many minutes, a whisp of pheromone-laden air curls around the male. His antennae intercept the stream of sex pheromone that signals a sexually-receptive female is somewhere upwind. He pivots excitedly to face into the oncoming stream of intermittent pheromone molecules. In an instant, his wings spread and he takes flight from the edge of the leaf. After a short period of slow, hovering upwind flight, punctuated by brief detours in and around several plants, the rising concentration of pheromone tells the male that the female must be near. He lands on a plant a few meters from where he began and finds her clinging to the underside of a leaf. He is the first male to arrive. After a brief negotiation, she accepts him and they mate. When completed, they go their separate ways; she will feed and start to develop eggs, he feeds to replenish his resources in preparation for another mating.



*Male WCR feeding in corn leaf collar.* Photo by Joe Spencer, INHS Center for Ecological Entomology

Movement is behavior at its most fundamental. When and where movement begins and ends, who moves, and how fast a mover goes all affect how individuals are distributed in populations. In WCR, like many species, mate-finding involves highly competitive males that move in response to plumes of sex-attractant pheromone they use to locate unpredictably distributed females that may only be receptive to potential mates for brief periods. Control actions of pest managers that affect insect distributions and/or the success of mate-finding can influence pest population dynamics.

Grower adoption of corn rootworm-protected *Bt* transgenic corn hybrids (varieties that express insecticidal toxins from *Bacillus thuringiensis* (*Bt*) that kill WCR larvae; adult WCR are not harmed by *Bt* corn) protects corn plants from economic injury and changes the abundance and distribution of WCR adults in cornfields. To delay rapid development of insect resistance to *Bt* toxins, by law, growers using *Bt*

*Continued on back page*

# Inventorying the Pyrenomycetes of the Great Smoky Mountains National Park

An All Taxa Biodiversity Inventory (ATBI) is currently underway in the Great Smoky Mountains National Park (GSMNP) and the sampling of fungi, especially microfungi, is vital to ensure a complete and thorough survey of all of the park's organisms. Fungi constitute the most diverse group of eukaryotic organisms (having cells with genetic material organized into nuclei) on earth, second only to insects in the number of species thought to exist. Although over 80,000 species of fungi have been described, some researchers suggest that as little as 5% of the total number of fungi have been identified.

Pyrenomycetes represent one of the largest groups of fungi. However, they are also one of the most poorly known, most likely due to their small size (usually less than 1mm diameter) and cryptic nature.

Pyrenomycetes contain both economically and ecologically important taxa such as the "fruit flies" of the fungal world (e.g., *Neurospora crassa*, *Podospora anserina*, *Sordaria fimicola*) as well as significant destructive pathogens including the causative agents of chestnut blight (*Cryphonectria parasitica*), dutch elm disease (*Ophiostoma ulmi*), and the recently discovered beech bark disease (*Nectria coccinea*). Pyrenomycetes occur in all ecosystems and geographical areas primarily as saprobes (organisms that obtain food primarily from decaying matter) where they play an integral role in forest and other ecosystems since they are intimately involved with such basic processes as nutrient cycling and decomposition of organic matter.

*Figure 1.* Cercophora "rubrotuberculata," *a new species to science found at Big Creek.* Photo by Andrew Miller, INHS Center for Biodiversity

The objective of this study is to inventory pyrenomycete fungi throughout the GSMNP to assess their diversity, abundance, distribution, and host specificity. Collecting occurs throughout the park at various elevations to sample a wide variety of habitats ranging from pine-oak forests to hardwood coves to northern red oak forests. All collections are entered into a database of pyrenomycetes of GSMNP, which includes historical records gathered from herbaria records from the University of Tennessee-Knoxville Mycological Herbarium and from the U.S. National Fungus Collections in Beltsville, MD. Collecting since 2004 has produced a total of 698 collections comprising 174 unique species. This effort has resulted in 123 new records for the park and 4 new species to science.

An inventory of this magnitude has never been conducted in the U.S. for pyrenomycetes. This study will provide important baseline data for making management decisions regarding the conservation and protection of biodiversity and will allow comparisons to be made with species in Illinois. This project benefits the Illinois Natural History Survey (INHS) in many different ways, especially through increasing our collections and providing outreach opportunities. Collecting in the GSMNP will greatly enhance the INHS Mycological Collections by providing hundreds of voucher specimens along with numerous type specimens from an under-represented area of the U.S. These specimens will be compared with material collected throughout Illinois and help establish fruiting patterns, abundance, species ranges, and host specificity. Numerous outreach opportunities are available through the various programs offered by the park. Through the Appalachian Highlands Learning Center, 20 high school students participated last summer in a pyrenomycete workshop and assisted in plot collecting throughout the southeastern part of the park. A week-long bioblitz was hosted in September 2005, which involved collaborators from INHS, The Field Museum, Chicago, USDA, Beltsville, MD, Washington State University, Pullman, and The Far East Branch of the Russian Academy of Sciences, Vladivostok, Russia. A Web site is currently being developed that will include information regarding the life history, characteristics, diversity, and distribution of pyrenomycetes throughout the park. An interactive identification system will also be created along with species pages for the most common taxa found in the park.

*Figure 2.* Xylaria longipes *growing on a moss covered hardwood log.* Photo by Andrew Miller, INHS Center for Biodiversity

*Andrew Miller, Center for Biodiversity*

# Illinois' Green Infrastructure

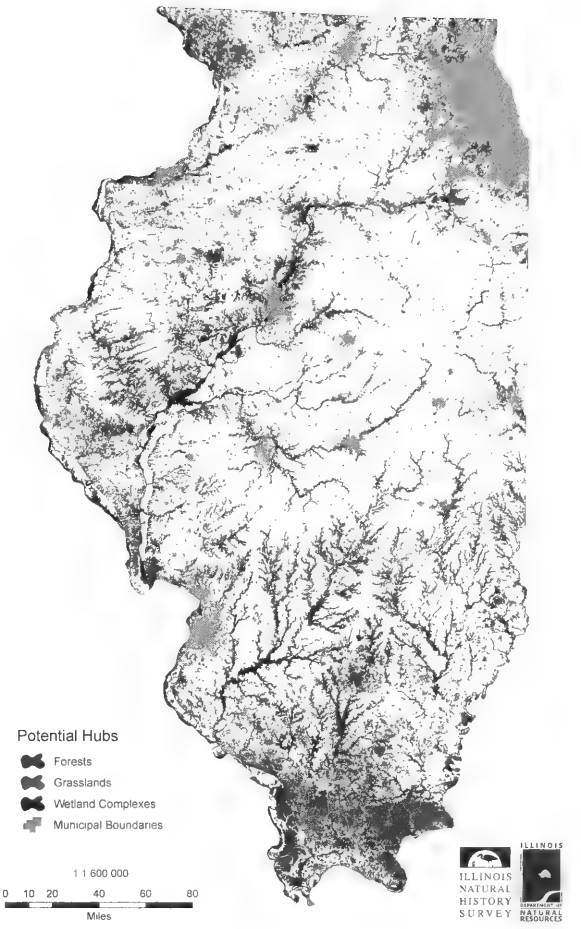
*No single park, no matter how large and how well designed, would provide the citizens with the beneficial influences of nature.*

— Landscape architect Frederick Law Olmsted, 1822–1903

The concept of "Green Infrastructure" was began with the idea of linking parks together for the benefit of people. Expanding the concept to include ecology and not just recreation was a natural next step. Green Infrastructure encompasses the most important natural lands, those that provide the bulk of our nation's natural life support systems. Many ecological services are provided by this land, such as cleaning the air, filtering water, storing and cycling nutrients, conserving and generating soil, pollinating crops and other plants, regulating climate, sequestering carbon, protecting areas against storm and flood damage, and maintaining aquifers and streams. If the ecological integrity of the land is preserved, then the continued harvesting of marketable goods and services, such as forest products, fish and wildlife, and recreation can be sustained.

The Green Infrastructure network consists of two components, core reserves or *hubs* and connecting links or *corridors*. Hubs are large patches of natural forest, grassland, and wetland vegetation that provide living spaces and areas of origins and destinations for plants and animals. These blocks of land are connected by corridors and anchor the network. Corridors are narrow strips of land that tie the system together and enable the network to function. In Illinois, corridors are linear remnants of natural land, such as forests and grasslands along streams and narrow wetlands that allow plants and animals to move from one hub area to another. Corridors also help to protect the health of streams by maintaining adjacent vegetation. The hubs and corridors can range in size, function, and ownership, but in order to be successful, they need to provide long-term protection.

In 2004, the Illinois Natural History Survey began applying the principles of the Green Infrastructure model to aid in the process of identifying and prioritizing areas for conservation and restoration. This study was done on a statewide scale, using Geographic Information System (GIS) technology and existing data sets. Hubs at least 100 acres in size were identified by combining forests, grasslands, and wetland complexes (buffered wetlands). Forests and grasslands were extracted from the Illinois GAP landcover data. Forested and emergent wetlands were identified from the Nation Wetlands Inventory (NWI). Size thresholds of 150 acres for forest, 40 acres for grassland, and 250 acres for wetland complexes (including buffer) were applied. Once all three landcover categories were combined, developed areas and major roads were removed and an additional size threshold of 100 acres was applied.




Corridors were identified from three different ecotypes: terrestrial, aquatic, and wetlands. Forests and grasslands along streams were identified from the Illinois Streams Information System (ISIS). Streams with high-quality aquatic resources were identified from the Biological Streams Characterization (BSC) – category A, and the Biologically Significant Streams (BSS) databases. Linear forested and emergent wetlands were extracted from the NWI. Areas that obstruct wildlife use and movement such as roads and urban areas were factored into the corridor data. The end result was a statewide network of hubs and connecting corridors.

The final step in this ongoing analysis is to rank the hubs and corridors according to their ecological importance and potential risk of loss due to development. Hubs are ranked on such factors as proportion of natural cover, threatened and endangered species presence, degree of present protection, patch shape, etc. Corridors are ranked on such parameters as length, road and railroad crossings, and proportion of natural vegetation. Hubs and corridors will be added together to produce a final statewide map. While all hubs and corridors of statewide significance are considered ecologically important, the relative rankings can be used to prioritize conservation efforts.

*Diane Szafoni, Center for Wildlife and Plant Ecology*

# Illinois Natural History Survey Library Grand Opening Celebration

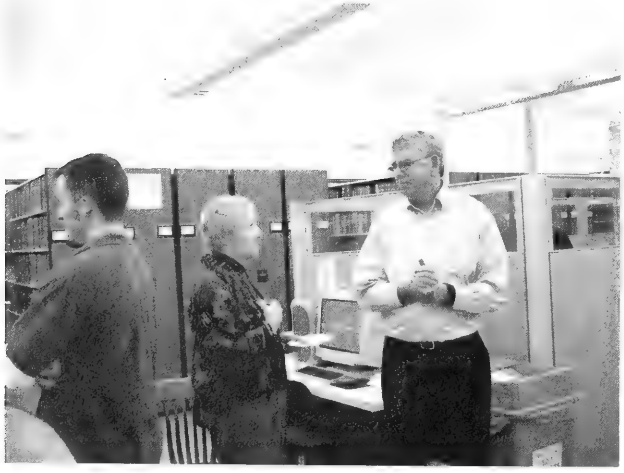
The Illinois Natural History Survey (INHS) Library had a grand opening celebration on Friday May 12. It was very well attended in spite of the cold rainy weather. INHS Chief David Thomas, University of Illinois Librarian Paula Kaufman, and Head INHS Librarian Beth Wohlgemuth spoke. There was plenty to eat and a drawing was held for INHS books and posters. Grand Prairie Friends – Prairie Grove Volunteers generously lent us their traveling quilt for this occasion.

The INHS Library moved into the I-Building on the University of Illinois at Urbana Champaign's South Research Park in December 2005 along with the Office of the Chief and the Center for Wildlife and Plant Ecology. Already housed in the I-Building were the INHS Center for Economic Entomology, the Education Outreach Office, the Publications Office, the Critical Trends Assessment Program, and the Illinois State Geological Survey.

The new library is very attractive and welcoming. Features include spacious reading areas, electric compact shelving that houses our 45,000 volumes, with enough space leftover for 20 years of growth, a Rare Book Room, and an Archives and Special Collections Room. There are three public terminals available for users to search the Internet or access the UIUC Library's on-line catalog and electronic resources. The INHS Library is a UIUC departmental library and our holdings are in their catalog. We contribute to on-line full text resources such as *BioONE* and *JSTOR Ecology* and *Botany Collection*, and citation indexes such as Cambridge's *Aquatic Sciences and Fisheries Abstracts 1*, *Fish and Fisheries Worldwide*, *Wildlife and Ecology Studies*, and *Birds of North America*.

*INHS Head Librarian Beth Wohlegemuth (L) and University of Illinois Librarian Paula Kaufman offer remarks at INHS Library Grand Opening.* Photo by Susan Braxton, INHS Office of the Chief

The collection includes a wealth of materials covering Illinois natural history, conservation, ecological restoration, systematics, agriculture and natural resource management, with several special collections of note. The *INHS Technical Reports* are housed in the Special Collections room and comprise over 700 reports. These reports are authored by survey scientists and are used by the INHS, the Illinois Department of Natural Resources, and other granting agencies to assess needs and formulate policy.



*INHS Chief David Thomas (R) chats with Janet Nevling.* Photo by Beth Wohlgemuth, INHS Office of the Chief

Also found in this room is an archives of over 5,000 articles and books authored by INHS staff that spans from the late 1800s to the mid-1980s. A complete collection of articles written by INHS founder Stephen Forbes is included in this collection. We no longer collect the physical items but maintain a searchable online database (http://reports.inhs.uiuc.edu/). This database also includes the records for the *Technical Reports*. The Illinois Survey Field Notes Collection contains the notes taken by the surveyors who actively mapped the state in the early 19th century. The collection is on microfilm. The library also has the Illinois Wetlands Inventory Map Collection, which locates, classifies, and maps the state's wetlands, lakes, and rivers. There is also a complete set of black and white aerial photographs of the state of Illinois.

Sadly, John Bouseman, INHS researcher and avid library supporter, was unable to join us at the opening and passed away the following day. John was responsible for establishing the INHS Library Endowment Fund. In 2003 he collected the initial $10,000 required to start the endowment. Today the fund has doubled and contains $20,320. We will miss John, but are grateful that his legacy of library support will continue. Donations to the endowment fund are always welcome and can be made on-line at http://www.inhs.uiuc.edu/donation/index.html.

*Elizabeth Wohlgemuth, INHS Office of the Chief*

# *In Memoriam*: John K. Bouseman

Illinois Natural History Survey (INHS) entomologist John Bouseman died at home on May 13. He was 69 years old. John worked at INHS for some 35 years, from 1968 until his retirement in 2003. John remained active even in retirement, teaching education outreach courses around the state and working on a new field guide of the skipper butterflies of Illinois, which is now in press and expected to be released in late summer of 2006.

John was born August 11, 1936 in Clinton, Iowa, a son of Thomas Elmer and Catherine Van Buer Bouseman. He grew up in Savanna, Illinois.

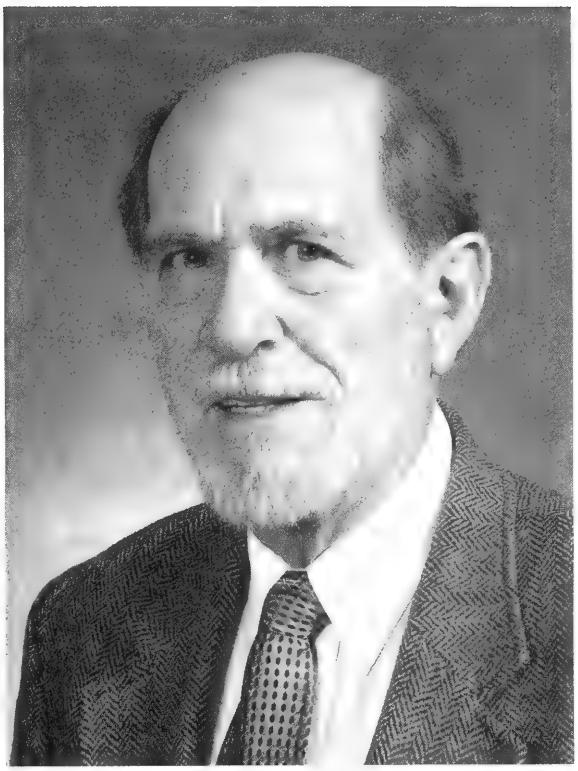
He married Tammie Moore on October 15, 1977 in Urbana. Tammie survives as do John's four sons David, Thomas, Paul, and William. John also has two daughters—Karen Vallowe of McLeansboro and Lynn Voges of Sparta—and seven grandchildren. His sister Ann Zimmerman also survives.

John was a member of the University of Illinois Book Collectors Club 44, Entomological Society of America, Lepidopterists Society, and Indiana Academy of Science. He was a co-author of *Field Guide to Butterflies of Illinois* (now in its second printing), *Field Guide to Silkmoths of Illinois*, as well as the soon-to-be-published *Field Guide to The Skipper Butterflies of Illinois*.

John served as chair of the INHS Library Committee for many years. He was instrumental in raising $10,000 to help establish an endowment fund for the INHS Library, which supplements funding from the State and University of Illinois. The fund has now grown to more than $23,000.

John was an avid collector of rare and first edition books on natural history subjects. He also enjoyed music and pizza from the Jolly Roger restaurant in Urbana, and he traveled to Asia, Europe, Africa, and South America during his career.

As a field biologist, John knew Illinois like the back of his hand. His work took him to virtually every county of the state, and he was intimately familiar with every habitat in which his favorite lepidopterans could be found.



INHS Chief David Thomas remarked to the *State Journal-Register* of Springfield that John was "one of our old-time naturalists. It is a shame to lose that source of tremendous knowledge."

John was a classic "gentleman and scholar" who sported a tweed jacket and leather Fedora. His friends and colleagues will miss his erudition on any number of natural history topics, his calm, laid-back demeanor, and his home-spun sense of humor that spiced up both casual conversations and professional presentations.

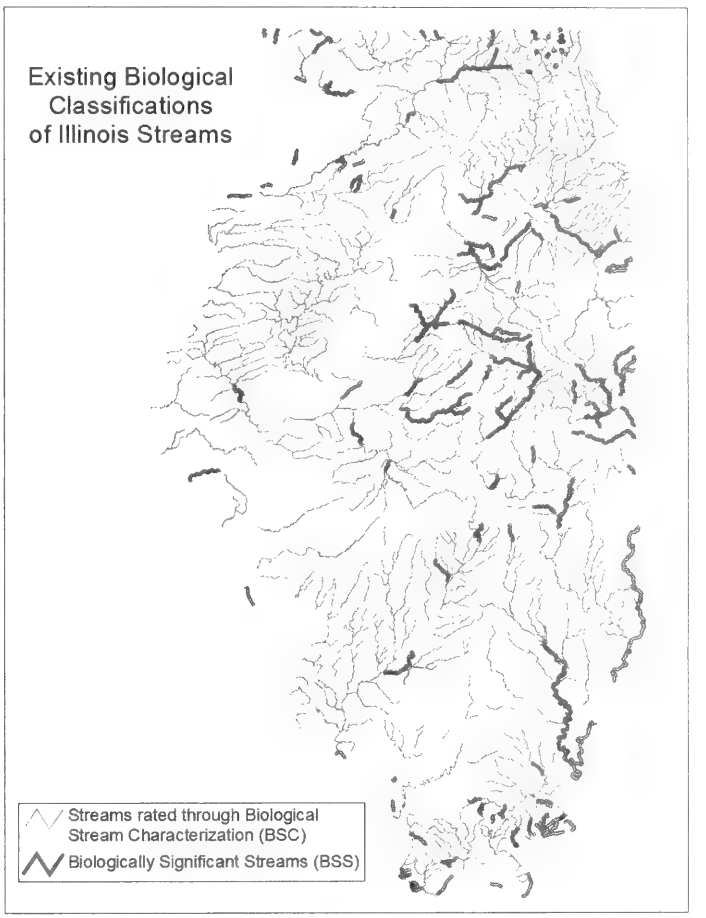
*Charlie Warwick, Office of the Chief*

# Evaluating Streams in Illinois Based on Aquatic Biodiversity

In 1984, the Biological Stream Characterization (BSC) Work Group convened to develop a multitiered classification of stream biotic integrity. Although widely used by Illinois Department of Natural Resource (IDNR) employees and other stakeholders throughout Illinois, the BSC process was limited in scope and used a fish-based Index of Biotic Integrity (IBI) as the predominant stream integrity indicator. The BSC process instituted this classification by assigning letter grades "A" through "E" to evaluated stream reaches but provided no ratings for streams lacking biological samples (see map). While BSC's goal was to update stream ratings on an annual basis and to publish revised BSC ratings every five years, the original ratings were only updated once to include streams sampled through 1993.

The Illinois Natural History Survey (INHS) addressed one of the BSC's shortcomings by integrating additional information (e.g., mussel diversity, threatened and endangered fish) into the stream rating process for BSC-rated streams. In 1992, INHS published a list of 132 biologically significant Illinois streams (BSS) for the purpose of concentrating protection efforts with a goal of protecting 100% of the stream-dependent biodiversity (Page et al. 1992; [see map]). Similar to the BSC process, BSS was not updated on a regular basis.

Despite the lack of regular updates, both BSC and BSS processes generated products that are used extensively by local watershed groups, environmental interest groups, municipalities, consultants, as well as state and federal agencies. In an effort to provide these diverse interest groups with current information, INHS and the IDNR Office of Resource Conservation are beginning a project to update stream ratings with integrated aquatic biodiversity information and to develop methods of updating ratings as new data are collected. A current project has been developing a classification system for Illinois streams based primarily on landscape characteristics. The stream classification will provide a standardized naming convention for stream reaches; however, no measure of biotic integrity is assumed in the stream types. We hope to evaluate the biological ratings developed in terms of stream types, thereby making it possible for Illinois resource managers to target restoration or protection measures regionally or by stream type.




Unlike the previous BSC and BSS processes that identified some high-integrity or biologically significant streams based on the presence or score of a single data source, we envision using a combination of data sources to determine each stream's rating. Although a map of updated ratings will be generated, the process used to combine data and subsequently to rate stream segments will be documented to ensure future updates can occur in a standardized manner. In addition, this system will be able to identify key habitats and community types in need of additional management or restoration as well as identify streams with insufficient data to prioritize survey efforts. The rating process will be essential for monitoring the effectiveness of proposed conservation actions and allowing resource managers to respond appropriately as new information is collected. This project began in June 2006 and will conclude in August 2007.

*Ann Holtrop and Leon Hinz, Center for Aquatic Ecology and Conservation*

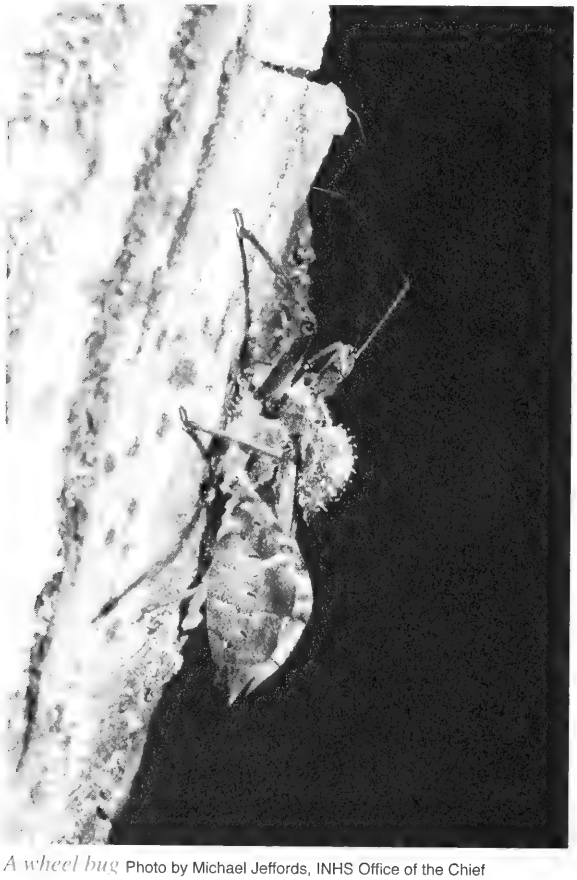
*Species Spotlight*

# Assassin Bugs et al.

Susan Post

Assassin, bloodsucking, masked hunter, wheel, and black corsair—do these names sound like plot lines or characters in the latest must read paperback? These aren't the names of human serial killers, but insects that belong to the family Reduviidae. While most of the members of this family are predators of crop and garden pests, a few suck blood and can inflict a painful bite if handled carelessly.

**Assassin bugs** can be almost an inch long and most are brown, black, or gray. Their heads are narrow and elongated with distinct "necks" behind reddish eyes and four-segmented antennae. The long, curved mouthparts form stout, strong beaks that are carried beneath their bodies with the tips fitting into grooves on the undersides. Assassin bugs belong to the insect order Hemiptera, which means half wings. The anterior regions of hemipteran wings are hardened and opaque while the posterior ends are transparent.



*A wheel bug* Photo by Michael Jeffords, INHS Office of the Chief

Most assassin bugs are generalist predators. While they eat many small insects, aphids and leafhoppers, they can subdue and kill caterpillars, such as the tomato hornworm. However, a few require a blood meal to complete their life cycle.

The bloodsucking **conenose** will feed on any mammal, including humans, and they can consume three times their body weight during a single feeding. Their head regions in front of their eyes range from cylindrical to conical in shape. They are found outdoors in hollow trees, in wood rat nests, or raccoon and opossum dens. Indoors, they can be found in bedding and floor and wall cracks. They are active at night, feeding on sleeping victims. They lay their white, pearly eggs only after a blood meal. The nymphs must also dine on blood in order to molt and can take up to three years to reach adulthood. This insect is the vector of Chagas disease in Mexico and Central and South America.

The **masked hunter** is also called the kissing bug and is attracted to lights. The name kissing bug was given during an outbreak in 1899. The insects would enter homes and bite sleeping humans on the face, especially the lips. They will enter houses in search of their preferred food—bed bugs. Eggs are laid singly in dusty cracks and corners. The nymphs are covered with a sticky substance to which dust and lint adheres, thus the mask. The nymphs are also called dust bugs. The nymph's camouflage is very effective as it can only be detected when moving. The masked hunter's bite is painful to humans.

The **black corsair** resembles the masked hunter except it has short wings and lives under stones and in hollow stumps. Corsair means pirate or buccaneer. Its bite is also painful.

The **wheel bug** has a semicircular crest behind its head, which resembles half a cogwheel. Nymphs lack this crest. This wheel has 8 to12 teethlike structures. This insect's bizarre appearance attracts attention. These insects are predators of tomato hornworms, fall webworms, and locust borers. Once they attack they will suck them dry! Wheel bugs overwinter as eggs, which are laid in masses of 10 to 40. By late summer adults are looking for mates and egg laying sites. They will bite if provoked, resulting in a sharp pain likened to a bee sting.

These unique insects should be admired at a "safe" distance, but if you should happen to be bitten, remain calm and try to collect the insect for positive identification. While the bites may cause discomfort, they are usually not life threatening.

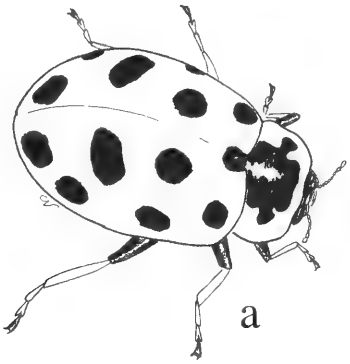
**The Naturalist's Apprentice Teacher's Page**

Answers to "What's in a Name" on the following page:
1-f, 2-b, 3-g, 4-e, 5-a, 6-c, 7-d

What's in a Name?

There are approximately 25,000 species of insects in Illinois and all of them must have names. While they all have scientific names, such as *Arilus cristatus*, many of them have common names as well. Common names of insects can be chosen to describe where they live, what they feed on, an unusual behavior, or they may be named after a person. Sometimes the common name simply describes its appearance. See if you can match the following descriptive common names below with the insect drawings on this page. (All drawings are by Carolyn Nixon, INHS.)

1. wheel bug _____
2. lace bug _____
3. zebra swallowtail _____
4. stag beetle _____
5. thirteen-spotted lady beetle _____
6. saddleback caterpillar _____
7. snout butterfly _____



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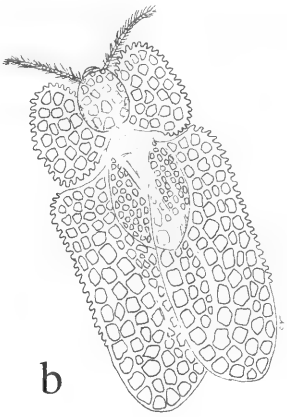

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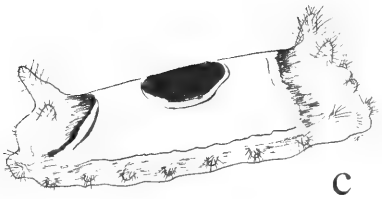

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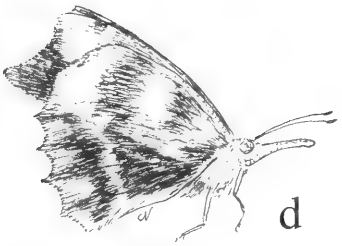

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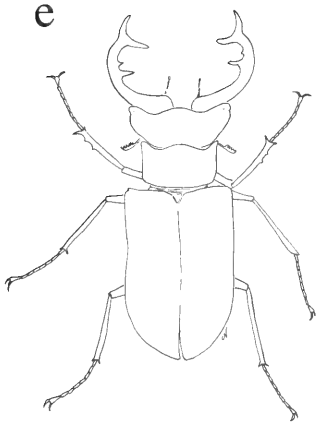

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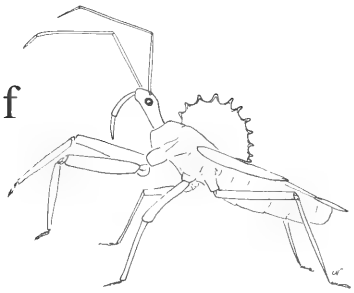

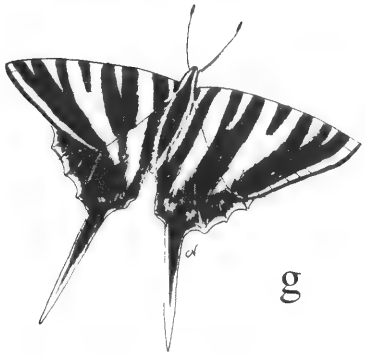

g

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## WCR Movement

*continued from front page*

varieties must also plant at least 20% of their cornfield area with non-*Bt* varieties. This area of non-*Bt* corn is called a refuge. It will yield a population of "susceptible" WCR that developed without exposure to the *Bt* toxin. Ideally, many susceptible insects leave the refuge and mate with the relatively few potentially-resistant WCR emerging from adjacent transgenic cornfields. Success of the refuge strategy depends on thorough mixing between WCR populations during the mating period. By saturating the *Bt* cornfield with *Bt*-susceptible WCR, few pairings between beetles that may both carry genes for resistance will occur. Because females mate soon after they emerge, desirable population mixing depends on rapid movement of refuge males into transgenic areas.

Since 2002, we have studied how quickly male WCR from refuges locate WCR females in *Bt* cornfields. The rate of male WCR movement from refuges into transgenic corn ranges from 6.4±0.9 to 11.0±1.1 m/day, with movement rates approaching 18 m/day in early season when females are scarce. Once females are abundant, males don't need to travel as far to find a receptive female. Less than 2% of males move 50 m or more a day. Our goal is to understand male movement patterns so refuges can be distributed in a way that gives refuge males a high probability of mating with females in transgenic cornfields. It is already recommended that refuges be planted as blocks or strips within *Bt* cornfields. Our results suggest regularly spaced in-field refuge strips, separated by 20 to 30 rows, will enable adequate refuge male infiltration into transgenic corn blocks.

*Dr. Joseph Spencer, Center for Ecological Entomology*

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ILLINOIS NATURAL HISTORY SURVEY Reports



Autumn 2006
No. 389

INSIDE



# Cache River Watershed

This issue of *Illinois Natural History Survey Reports* highlights some of our research, education, and outreach efforts in this unique habitat in southern Illinois. A number of the staff reporting on their work in this issue participated in the Cache River Symposium, which focused on highlighting work over the last 10 years to advance the restoration of this internationally significant wetland ecosystem. I was pleased to participate on the planning committee for this conference. The Illinois Natural History Survey (INHS) is proud to be a part of the major restoration efforts occurring on the Cache, and to continue to be involved in the development of this ecologically significant habitat.

I have had the pleasure in my tenure as Chief of the Survey to join various staff members on the Cache. An outstanding memory is walking on a cold December morning to the overlook at Wildcat Bluff. There we started counting all birds heard and sighted for the annual Christmas Bird Count, and as the first light dawned we looked over the expanse of bottomland forests with the Cache River winding through it and saw basically only wild America. You really felt that you were in Illinois a few hundred years ago, and that the Pileated Woodpeckers we saw flying below us could have been Ivory Billed Woodpeckers. And later, walking the bottomland forest we could appreciate the diversity of trees and the many species of birds that used this area for overwintering, or as an important stop on their migrations south. One year our group recorded over 350 Red-headed Woodpeckers overwintering in this portion of the Cache—a large number for this species whose global population continues to decline.

*The Cache River watershed in winter as seen from Wildcat Bluff.* Photo by James Anderson

I also remember being at Grassy Slough in the spring when a large number of Willets and other shorebirds were present, and one late fall when Short-eared Owls, Northern Harriers, and other hawks worked the fields and wetlands. The Cache has a great diversity of habitats, and each year brings additional changes in the flora and fauna as restoration and succession continues.

Survey research over the last 15 years in the Cache and Shawnee Hills has demonstrated the impact of habitat fragmentation on Neotropical migrant birds, and has lead to management changes that are resulting in more unbroken forest habitat which will enhance the reproductive success of a number of forest nesting species. The work reported here by Dr. Jeff Hoover has lead to increased appreciation of the need to manage water levels to enhance the reproductive success of the Prothonotary Warbler and other wetland species. We will continue to look for opportunities to inform those involved in the restoration of this area and other wetland areas around the state through our research and outreach efforts.

*David L. Thomas, Chief of INHS*

# INHS Research Assists Restoration Efforts in the Cache River Watershed

Floodplain forests and their associated wetlands are among the most productive, biologically diverse habitats in the world. In bottomland forest ecosystems, the interplay of topography and hydrology creates and maintains a complexity of habitats and promotes high levels of biodiversity. Intact bottomland forest ecosystems are especially valuable because they support a high diversity and density of numerous organisms, including breeding Neotropical migratory birds. Bottomland forests are, however, an example of a habitat in peril. In the U.S. less than 20% of a historical area of over 100 million ha of bottomland forest remains and the loss of bottomland hardwoods is nearly five times greater than for any other major hardwood forest type. During the past 150 years, the combined effects of logging, draining, and farming have altered and fragmented many bottomland forest ecosystems. Those bottomland forests that remain are often degraded and functioning poorly for organisms residing therein. In recent years, the importance of bottomland forests has been recognized and efforts are now being made to acquire, restore, and conserve this habitat type.

*The Cache River watershed is home to the northernmost cypress swamp in North America.* Photo by Jeff Hoover, INHS

The Cache River Wetlands Restoration Project, located in the southern tip of Illinois, is one of the largest high-profile habitat restoration projects in North America. The ultimate goal of the restoration project is to acquire, restore, and manage over 60,000 acres of land as bottomland forest within the Cache River watershed. The project is a joint venture involving the U.S. Fish and Wildlife Service (USFWS), The Nature Conservancy (TNC), the Illinois Department of Natural Resources (IDNR), and Ducks Unlimited (DU). Presently over 32,000 acres of land are managed by the joint venture partners, much of which has been taken out of agriculture and planted with a mixture of bottomland tree species during the past 14 years.

Scientists from the Illinois Natural History Survey (INHS) have been conducting research in the Cache River watershed for many years. Scientific research is an important component of conservation plans and restoration efforts. Research on the bird community in the Cache River watershed of Illinois has provided a unique opportunity to document the effects of conservation actions and provide direction for restoration practitioners. Research efforts during 1993–1995, prior to the bulk of the restoration, determined that bird species diversity increased with bottomland forest width and that nesting success was highest (relatively low rates of nest predation and cowbird parasitism) in the least fragmented forests within the Cache River watershed. More recently on our study sites that were adjacent to agriculture (row-crop or pasture) but now are adjacent to early-successional forests (as a result of land acquisition and reforestation), we have seen a 20–40% reduction in rates of cowbird parasitism compared to sites that still are adjacent to agriculture and have consistently high rates of cowbird parasitism. These results have helped the joint venture partners establish land acquisition priorities. Land acquisition that increases the amount of forest interior (forest greater than 500 m from agricultural land use) by widening or consolidating preexisting bottomland forests should greatly benefit birds breeding in the Cache River watershed.

The Prothonotary Warbler has been a focal species for studying how natural processes such as hydrologic fluctuations affect the function and value of bottomland habitat for songbirds. Prothonotary Warblers require forested wetlands for breeding and prefer to nest over water (in tree cavities or nest boxes). Since 1994 we have monitored over 5,000 warbler nests and we now know that fluctuations of water levels in swamps and forested wetlands influence nest predation, in turn affecting the season-long productivity of these warblers. Raccoons were responsible for the majority of nesting failures and rates

*Continued on page 5*

# Warblers Provide Link Between Behavioral Ecology and Conservation Biology

Studies of the behavioral ecology of Prothonotary Warblers in the Cache River watershed have allowed us to gain a better understanding of some of the most important yet poorly-known aspects of migratory songbird behavior that profoundly affect their population dynamics. These behaviors include the between-year fidelity of adult warblers to breeding sites and the dispersal of warbler offspring away from their place of birth (natal dispersal). The Prothonotary Warbler is a migratory songbird that winters in the Neotropics (Central America to northern South America) and breeds in forested wetlands throughout parts of the eastern half of the United States. This species is territorial during the breeding season, nests in secondary cavities and nest boxes, and prefers to nest over standing water in bottomland and swamp forests. Prothonotary Warblers are also easy to capture, individually mark, follow for an entire breeding season, and relocate in subsequent years. These characteristics make the warbler ideal for studying site fidelity and natal dispersal of a migratory songbird in a bottomland forest ecosystem.

*A Prothonotary Warbler that nests and breeds in the Cache River watershed.* Photo by Jeff Hoover, INHS

By experimentally improving nesting success for some pairs of warblers but not others, we demonstrated that individual male and female Prothonotary Warblers decide whether or not to return to sites within the Cache River watershed based on their reproductive performance. Individuals producing two batches (broods) of offspring in a breeding season returned to the same habitat patch the following year at a rate of 80%. Individuals producing one brood returned at a rate of 50% and only 25% of those producing no offspring returned the next year. The warblers use their own nesting success as a cue to return to good sites and to avoid returning to bad ones. These "decision rules" lead to increased densities of warblers on good sites because many of the breeding adults return year after year, and also because the presence of these returning adults is attractive to other warblers (including older birds who were on a bad site the previous year and 1-year-olds breeding for the first time) looking for a good place to breed. The effect of the presence of individuals of the same species on the settlement pattern of others is called "conspecific attraction." The presence of many returning adult birds on a site may indicate to new birds that it is good-quality breeding habitat much in the same way that a crowded restaurant likely indicates to passers-by that the food is good there.

The results of this initial study provided a link between behavioral ecology and conservation biology by showing the inter-connections between several features of the bottomland system and the behavior of the warblers. Habitat fragmentation and degradation in bottomland forest ecosystems increase raccoon densities (the primary nest predator), and affect hydrologic fluctuations that influence raccoon movements and rates of nest predation. Nest predation by raccoons limits the nesting success of Prothonotary Warblers, the subsequent return of warblers between years, and ultimately the local population dynamics of the warblers. By consolidating forests and managing hydrology in forested wetlands (maintaining deep water during the breeding season), local populations of warblers will thrive and be highly productive.

Natal dispersal, the movement from a natal site (place of birth) to a new breeding site, is probably the most important and least understood

*Continued on page 5*

# Molecular Phylogeny of *Cuerna* Leafhoppers Suggests Hybridization

Although using DNA sequences as unique signatures (barcodes) for identifying species is becoming increasingly popular, numerous recent studies have warned that exclusive reliance on sequences of one or several genes may lead to errors. Occasional hybridization or retention of ancestral variations can result in different species sharing identical sequences or, alternatively, different populations of the same species displaying highly dissimilar sequences. Here we describe examples of both such patterns encountered during our study of the systematics and evolutionary biology of the widespread North American leafhopper genus *Cuerna*. In this National Science Foundation—funded research we sequenced 2 mitochondrial genes from 140 individual leafhoppers representing 25 of the 31 known species of the genus.

Two southwestern species, *C. curvata* O. and B. and *C. yuccae* O.and B., differ from one another in the structure of both male and female genitalia (Fig. 1). Gene sequences sampled from four populatons of *C. yuccae* were significantly (2–2.5%) divergent from those sampled from three populations of *C. curvata*. However, a population of *C. yuccae* from Snow Canyon State Park in Utah had mitochondrial sequences identical to those of *C. curvata*. This area is one of the few where these species occur together. While *C. yuccae* feeds on Joshua trees and *C. curvata* on single-leaf pinyon pines, apparently in both species mating and laying eggs take place on the same herbaceous plants near the ground. We hypothesize that mitochondrial genes of *C. curvata* have introgressed into the population of *C. yuccae* via a rare hybridization event, which must have occurred despite differences in the structure of the genitalia of the two species.

Extinction of one of the species involved in introgressive hybridization or incomplete sampling can result in discrepancies between morphological and molecular traits, which can be difficult to interpret. This can be illustrated by the example of *C. alpina* O. and B., which


*Figure 1.* Cuerna curvata *(left) and* Cuerna yuccae *(right). The two species differ in the structure of the male (top) and female (bottom) genitalia.*

we have rediscovered in Illinois. This grassland species (Fig. 2) occurs in the Rocky Mountains and western prairie states, including New Mexico, Kansas, Nebraska, and the Dakotas. An earlier study of the genus also included Illinois in the species' range, but, because no specific locality was given and no specimens of *C. alpina* were found in Illinois museums, this isolated record from the Midwest appeared erroneous until we actually found specimens from Illinois among material borrowed from the Canadian National Collection. They were collected in 1950 and 1962 at Prairie du Rocher and Fults (Randolph and Monroe counties) by Illinois Natural History Survey (INHS) entomologist Herbert Ross and botanist Robert Evers, who at the time were conducting a survey of hill prairies of Illinois. In September 2005, we found *C. alpina* at Fults Hill Prairie Natural Preserve on a Mississippi River bluff. This population is 350 miles east of the nearest previously known locality of this species. The mitochondrial gene sequences from the Illinois specimens turned out to be very different (4.2–4.6%) from sequences obtained from *C. alpina* collected in New Mexico, Colorado, Nebraska, and Montana. In the phylogeny of the genus, reconstructed from these sequences, the Illinois population appears as a distinct lineage, not closely related to the cluster of western populations or to any other *Cuerna*. A possible explanation is that some populations of *C. alpina* may have acquired mitochondrial DNA through hybridization with a different species, which is either not represented in our dataset or is extinct. The genetically unique population of *C. alpina* in southern Illinois sheds light on the convoluted history of the genus and deserves both preservation and study. Further research is needed to elucidate the possible role of hybridization, previously undocumented, in the evolution of *Cuerna* and related leafhoppers.


*Figure 2.* Cuerna alpina.

*Roman Rakitov and Sindhu Krishnankutty, INHS Division of Biodiversity and Ecological Entomology*

## Cache Restoration

*Continued from Page 2*

of nest predation decreased with increased depth of water beneath nests. Nests over water deeper than 60 cm (2 feet) were particularly successful because raccoons apparently like to wade but not swim in water when foraging for crayfish and other aquatic organisms. The nesting success of these migratory warblers drives the site fidelity of the adults, the dynamics of local populations, and whether the watershed is a "source" or a "sink" for the species. Forested wetlands and swamps that have deep water in them for a long (1–3 months) duration during the warblers' breeding season (May–July) are critical to the nesting success and maintenance of healthy populations of Prothonotary Warblers.

Channelization of rivers and streams threatens bird species dependent on forested wetlands because it can lead to the formation of lateral gullies that connect streams to adjacent wetlands and drain the wetlands. These wetlands may fill during spring floods and be attractive breeding habitat for birds, but the unnaturally rapid draining of the wetlands early in the breeding season may lead to high rates of nest predation. When wetlands are drained by gullies, the water beneath Prothonotary Warbler nests becomes shallower, exposing the nests to increased rates of nest predation by raccoons. Habitat fragmentation, the draining of wetlands, and stream channelization may act synergistically to elevate rates of nest predation in forested wetlands. Conservation actions designed to stop or reverse these processes will be especially beneficial to birds breeding in bottomland forest ecosystems.

Conservation partners (IDNR, TNC, USFWS) in the Cache River watershed are attempting to reduce habitat fragmentation and consolidate bottomland forests through land acquisition and reforestation. They are also restoring "natural" hydrologic processes by reducing the effects of stream channelization and by plugging some of the lateral gullies that currently drain adjacent (off-channel) forested wetlands. When these gullies are plugged, the water is held in the wetlands at a greater depth and for a longer duration, resulting in increased nesting success for Prothonotary Warblers. As habitat restoration in the Cache River watershed proceeds, we are poised to document how changes in land-use, landscape composition, and specific management practices affect the bottomland forest bird community. Continued research in this system will expand our knowledge and increase our ability to effectively and efficiently restore and manage bottomland forests. It will also provide a means to measure the success of restoration activities in the Cache River watershed and inform conservation plans and restoration efforts in other bottomland forest ecosystems.

*Jeff Hoover, INHS Division of Ecology and Conservation Sciences*

## Cache Warblers

*Continued from Page 3*

life history trait. It is fundamental to the ecological understanding of landscapes, populations, and organisms, and a necessary consideration when devising conservation plans. Natal dispersal has remained a mystery in migratory songbirds, largely because few of the nestlings banded on study sites ever return to those sites in subsequent years. This has left researchers and conservation practitioners wondering if the birds not returning are dead or if they have dispersed to locations (nearby or distant) outside of the study or management area.

During the past 11 years, we have banded more than 4,000 Prothonotary Warbler nestlings in the Cache River watershed, and searched for them in subsequent years to get an idea of natal dispersal distances (distance between birthplace and location of first breeding). We expanded our search during the past two breeding seasons to include other appropriate habitat within the watershed, and also to habitat 20–40 km away from the primary study area. To date, over 300 warbler nestlings have returned to breed. We have found that the vast majority (>80%) of returning nestlings breed within 3 km of where they were produced. We viewed over 2,500 breeding adult warblers 20–40 km away from the study area and not a single one was banded. Warbler offspring appear to recruit into the population near where they were produced. Simply put, it seems that birds produced in the Cache return to the Cache. The great management implication of this result is that local conservation efforts that improve nesting success (e.g., land acquisition, restoration, consolidation of forests, managing water levels) will benefit local population dynamics and provide an even greater benefit to the local bird community.

In association with the natal dispersal research, we are now poised to use stable-isotope analysis techniques to address the question: Are local populations of Prothonotary Warblers maintained by local reproduction or by birds that are dispersing into the system from distant sources? Hydrogen isotope ratios in birds' feathers reflect those of local precipitation. This measure has been useful in assessing the origins of migratory species because there is a strong north to south gradient in hydrogen isotope ratios. The stable-isotope signature is assimilated into feathers through the food chain: plants take up rainwater, insects eat plants, and birds eat insects while growing their feathers. Once the feather is grown, its stable-isotope signature does not change. Therefore, a feather grown by a juvenile bird on the breeding grounds (at its birthplace) will bear the stable-isotope signature of that location. One difficulty, however, is that most migratory birds molt their natal (juvenile) feathers prior to returning to breed for the first time. The Prothonotary Warbler is one of few migratory songbirds that retains its natal tail feathers through the first breeding season, therefore allowing us to determine its point of origin. Stable-isotope analysis of tail feathers collected from 1-year-old warblers will allow us to determine the proportion of new recruits in the breeding population that are from local versus distant sources, and assess the effectiveness and benefits of local conservation actions in the Cache River watershed for migratory birds breeding there.

*Jeff Hoover, INHS Division of Ecology and Conservation Sciences*

# A Cache Full of Activity

*A small, wiry man with a gray pony tail sits on a small hill, diligently sketching the landscape before him while a line of canoes stretches off into the distance, quietly invading the dense, deep, primeval swamp.*

*A sea of children, disembarking from a bevy of yellow school buses lines up and proceeds through an arch decorated with large photos of Illinois insects and into a college gymnasium. Their fervor and excitement precede them like a palpable wave.*

*A large, white van with colorful graphics sits chugging with a not-so-quiet generator in the parking lot of the new Henry N. Barkhausen Wetlands Center, while children and adults in a long line await their turn to enter.*


The INHS Mobile Science Center is one of two travelling educational units that bring natural science to the citizens of the state. Photo by Michael Jeffords, INHS

What do all of these seemingly unrelated events have in common? They are all activities and programs involving education/outreach activities in the Cache River, initiated by the Illinois Natural History Survey in partnership with the Cache River State Natural Area and the Cypress Creek National Wildlife Refuge.

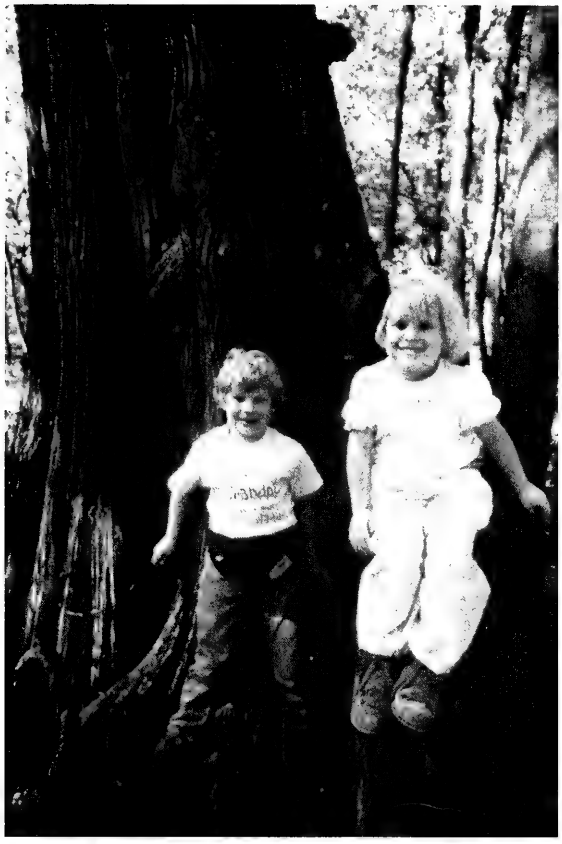
This Cache Corps of Discovery (CCD) was created in early 2006 and was modeled after the Lewis and Clark Expedition. Survey scientists Dr. Michael Jeffords, Susan Post, and Carie Nixon developed the idea to create a volunteer group of citizens who would be trained in the skills of nature photography, descriptive writing, and sketching/drawing. Following training they would be "turned loose" on their adopted landscape, in this case the Cache River ecosystem, to aesthetically document the biodiversity of this unique area and the changes that are taking place as restoration efforts proceed. Twenty-nine individuals make up the CCD and are working on various special projects, including creating an interpretive trail for the new visitor's center and a yearly exhibit of their work. A series of points and transects have been established to aid in their observations. These are termed Aesthetic Points and Pathways.

Every two years, the partners listed above, with help from the local Regional Office of Education, put on an Insect Expo for elementary school-age children from the region. The event is held in late March, and attracts from 1,500–3,000 children from a 100-mile radius of the host site at Shawnee Community College. The one-day event features 30–40 interactive exhibits on insects and arthropods and includes several performances of Insect Theatre. All the activities are loaded in a large trailer and brought to the area from Champaign the day before. Local citizens and high shool students help staff the booths. The event is always very popular and provides scientific content to schools in a very underserved region of Illinois.

The INHS Mobile Science Center (MSC) makes regular visits to the Cache River area, usually in conjunction with the Southern Illinois Birding Blitz, held each April. In 2006, Cypress Creek National Wildllife Refuge provided funds to create an exhibit that focused specifically on the biodiversity of the region with special emphasis on the avian fauna. The MSC often spends the week in the area, also visiting the Environmental Days held at the UI Dixon Springs Forest Resource Center.

The Cache River area is, and will continue to be, a focus of INHS outreach because it is one of the most unique systems in the state, country, and the world. It has been designated a "wetlands of international importance," and it also lies in one of the areas of Illinois that has little access to museums and other scientific institutions that provide hands-on interaction with science and scientists. The Survey is in a unique position to provide what Stepehen A. Forbes called "science for the people."

*Michael R. Jeffords, INHS Office of the Chief*



Children enjoy a hands-on introduction to cypress trees in the Cache watershed. Photo by Michael Jeffords, INHS

Workshop participants are encouraged to work "up close and personally" with their natural subjects. Photo by Michael Jeffords, INHS

Children are not the only ones enticed to the Cache. Above, participants and instructors in an INHS nature photography workshop pause for a group portrait. Photo by Michael Jeffords, INHS

INHS herpetologist John Petzing conducts education/outreach field trip for workshop participants in the Cache watershed. Photo by Michael Jeffords, INHS

# INHS Researcher to Be Inducted into Illinois Outdoor Hall of Fame

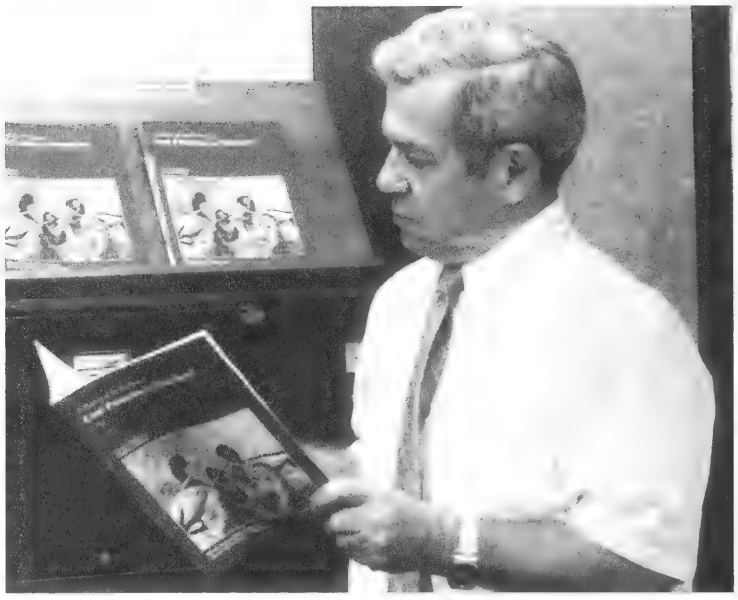
INHS mammalogist Dr. Glen C. Sanderson will be one of four new inductees of the Illinois Outdoor Hall of Fame on February 3, 2007. The hall of fame is a program of the Illinois Conservation Foundation.

These four individuals are being recognized for distinguished service and commitment to natural resource protection and outdoor recreation in the state. "They have records of service to the citizens of Illinois and to their communities that make them ideal choices for selection to the Illinois Outdoor Hall of Fame," said Illinois Department of Natural Resources Acting Director Sam Flood, who serves as the chairman of the board of directors of the Illinois Conservation Foundation. "Each of them has been honored many times for accomplishments in their individual careers. We are proud to add to the lists of honors the selection to the Outdoor Hall of Fame."

Glen C. Sanderson of Champaign, a renowned wildlife biologist with more than 50 years of service to Illinois, is considered one of the world's leading authorities on the biology and ecology of raccoons and one of the country's leading advocates for development of nontoxic shot to alleviate lead poisoning in waterfowl.

Renowned INHS waterfowl biologist Frank Bellrose wrote that Sanderson was selfless in placing the research of others ahead of his own. According to Bellrose, Dr. Sanderson conducted several important laboratory studies on nontoxic alternatives to lead shot. One of these alternatives was bismuth, which is being used to this day for such purposes.

Dr. Sanderson is also well known for his leadership of the preservation of the endangered prairie chicken in southeast Illinois. For almost 30 years he coordinated efforts of the Illinois Nature Conservancy, the Illinois Department of Conservation, and INHS that resulted in innovative methods of land acquisition and management for prairie chicken habitat. Under his leadership, two remnant and endangered flocks were preserved for posterity.



Sanderson produced more than 90 scientific publications including 55 scientific papers on the population biology of raccoons, the impacts of lead poisoning in waterfowl, the effectiveness of steel shot for hunting, and other topics. He also edited a number of journals and symposia proceedings such as *Journal of Wildlife Management*, *Midwest Furbearer Management Symposium*, *Migratory Shore and Upland Game Birds of North America*, *the Wild Turkey Management Symposium*, and *A Review of the Problem of Lead Poisoning in Waterfowl*—an INHS special publication.

Among the organizations that Glen served in a volunteer capacity are the University of Illinois Natural Areas Committee, the Illinois Chapter of of The Nature Conservancy Stewardship Committee, the Champaign County Forest Preserve District Advisory Committee, and the Illinois Conservation Police Merit Advisory Committee.

Dr. Sanderson received the prestigious Aldo Leopold Award for distinguished service to wildlife conservation from The Wildlife Society in 1992, the highest honor that can be bestowed on wildlife professionals. In addition Sanderson is listed in "Who's Who in America" and the recipient of American Motors' Conservationist of the Year, The Nature Conservancy Oak Leaf Award, the North Central Section of the Wildlife Society Appreciation Award, and the Illinois Chapter of The Wildlife Society Professional Award of Merit.

A World War II veteran, Sanderson began work in 1949 as a wildlife biologist in Iowa before joining the Illinois Natural History Survey in 1955. He became the INHS Center for Wildlife Research director in 1964 and was later named to the rank of Principal Scientist in 1989. At that time, he was one of only three scientists in the history of INHS who had achieved this rank. Since his retirement in 1990, Dr. Sanderson has remained an active researcher and mentor.

According to nomination letters for his induction into the Illinois Outdoor Hall of Fame, Glen Sanderson brought thousands of dollars of research grants for conservation into the state. Students, researchers, educators, policy makers, and elected officials have all been recipients of his guidance and expertise on the natural resources of Illinois. He set high standards of professional conduct for his staff by working harder than everyone else. He ways always willing to invest the time and energy to mentor and assist those in his charge.

# New INHS Publications

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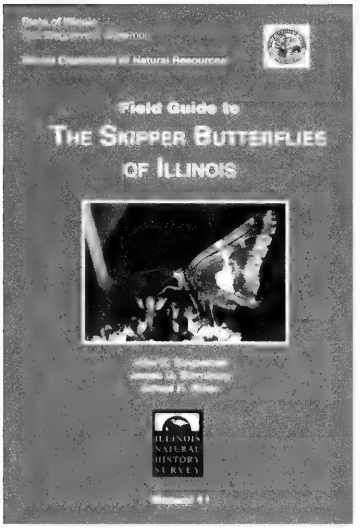


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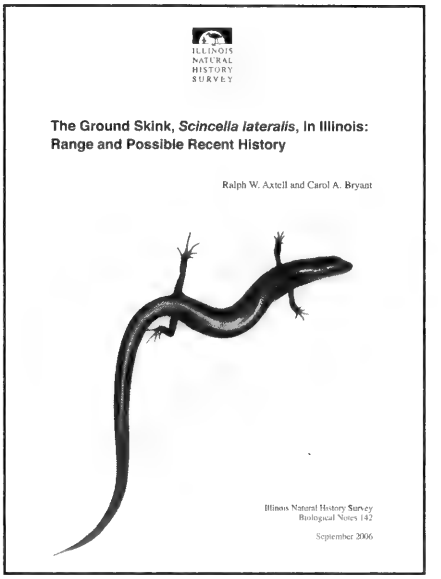


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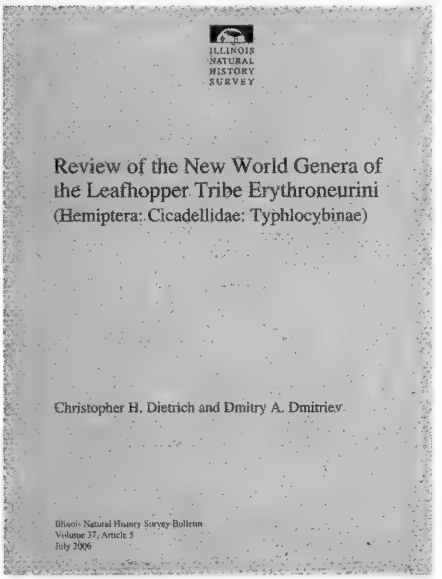


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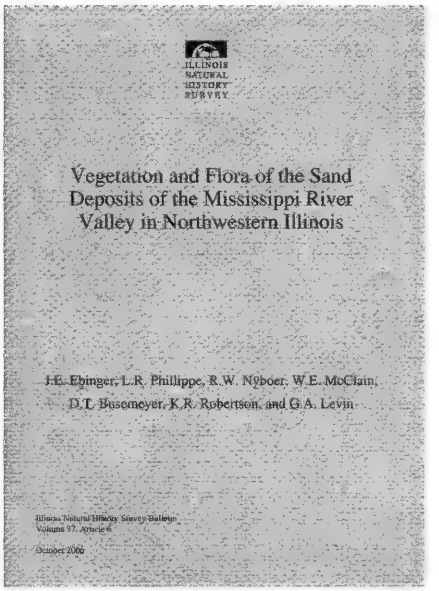


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*Species Spotlight*

# Jack-O-Lantern Mushroom

Darrell Cox and Andrew Miller

The Jack-O-Lantern mushroom, *Omphalotus olearius*, (also known as *Omphalotus illudens*) is a common late-summer-to-fall mushroom of the midwestern and eastern United States. It gets its common name not only because of its bright pumpkin orange color and its occurrence around the time of Halloween, but also because it can exhibit an eerie glow known as bioluminescence—the production of light by a living organism—in this case, a fungus. *Omphalotus olearius* is especially appropriate here in Champaign-Urbana since it is among the few mushrooms which display the "Illini orange" color.

The Jack-O-Lantern fungus produces large clusters of mushrooms around the bases of dead hardwood trees and stumps. They can also grow from buried roots. The yellow-orange to orange cap is first convex in shape, becoming flat and then finally funnel-shaped with a margin that turns downward. Underneath the cap are found similarly-colored narrow, decurrent (running down the stalk) gills, and a pale orange, thick stalk.

*Jack-O-Lantern mushrooms.* Photo by Darrell Cox, University of Illinois

Jack-O-Lanterns are attractive and have a pleasant odor, but are POISIONOUS! They are sometimes mistakenly eaten by people who think they are chanterelles. Chanterelles are similarly colored, can occur around the same time of the year, and are good edibles. However, chanterelles are smaller in stature, have gills that are not well developed (appear more like veins), and usually grow solitarily on soil. Experiencing poisoning by *O. olearius* has been described as at first being afraid you're going to die, then being afraid you're not going to die, and finally, after several hours of abdominal pain and vomiting, you begin to feel better.

So if you can't eat it, and other than being a cool, charismatic mushroom and an organism worthy of appreciation and scientific curiosity, what good is it? Would you believe it's a cancer killer? Illudin S, a compound produced by Jack-O-Lantern mushrooms was known to have anti-cancer capabilities over 30 years ago, but it was also too toxic for humans to endure. More recently, researchers at the University of California-San Diego synthesized an anti-cancer compound from the toxins of the Jack-O-Lantern, which shows promise in treating a number of human cancers. The new drug, Irofulven, has the capability of causing programmed death of cancer cells, and is currently being tested in clinical trials as a chemotherapy agent for a number of different cancers.

*Omphalotus olearius* is also one of more than 40 species of bioluminescent fungi. The eerie light emitted by these mushrooms or by the actively growing mycelium of these fungi growing in decaying wood is a phenomenon referred to as "foxfire" and was reported as early as 382 B.C. by the Greek philosopher Aristotle. The recognition that luminous wood was actually caused by fungi was reported in 1823, and people in the far north are reported to have marked forest trails with pieces of rotten, glowing wood to enable them to find their way back at night. It is the gills of the Jack-O-Lantern mushroom that exhibit bioluminescence. This phenomenon can be demonstrated by bringing fresh and actively growing mushrooms into a dark room at night—the darker the better. Stare at the gills of the mushrooms until your eyes become accustomed to the dark, and you may eventually see the greenish glow given off by them. Although the reason, if there is one, that fungi glow is unknown, some suggest it functions to attract animals or insects that eat the mushroom and aid in the dispersal of its spores.

## The Naturalist's Apprentice Teacher's Page

Notes to the teacher: If the room is very warm, the mushroom may deteriorate quickly and be difficult to remove from the paper. In this case, if it is possible, place the paper with the mushrooms on it in a refrigerator. This will slow down the deterioration. It may also slow the release of the spores.

To write a date and location on the black paper, use a white- or yellow-colored pencil.

*The Naturalist's Apprentice*

# Make a Mushroom Spore Print

Carolyn Nixon

Mushrooms are the reproductive bodies of a fungus. Their purpose is to produce spores, which are like the "seeds" for a fungus. Different species of fungi have different types and colors of spores, and mushrooms release the spores in different patterns, depending on the shape and pattern of the underside of the mushroom cap. Some caps are smooth on the bottom with many tiny pores. These release the spores evenly across the surface. Others have gill-like structures that tend to release spores in a raylike pattern.

Mycologists (scientists who study fungi) use spores as one of the characteristics in identifying a fungus. The color of the spores, their shape and surface texture, and the pattern of how they are released are all important. While the size and shape of the individual spores are only visible with a high-powered microscope, the color and pattern of release are easy to determine by making spore prints.

*mushroom showing gill pattern on underside*

To make spore prints from mushrooms, you will need:

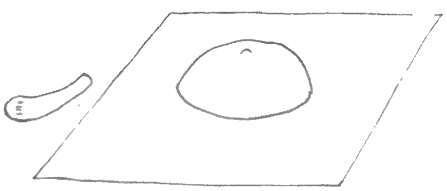
- heavy weight paper in both white and black
- fresh, mature mushrooms that are not deteriorating
- damp cotton balls or pieces of paper towel
- bowls or glasses large enough to fit over a mushroom

If you want to save your spore prints, you will also need:

clear acrylic spray, laminating film and laminator, or clear contact paper

To produce a spore print from a mushroom:

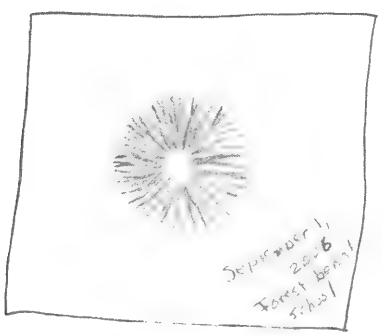
1. Cut or pull the stem from the mushroom cap.
2. Place the mushroom cap, top side up, on a piece of white or black paper. If you have more than one of the same type of mushroom, place at least one on each color of paper. Note: be sure to write the date and location where the mushroom was collected on the piece of paper.
3. Place a damp cotton ball or piece of damp paper towel on top of the mushroom. This will help keep it fresh longer.
4. Place an upside-down glass or bowl over the top of the mushroom to help keep the mushroom moist.
5. If possible, check the paper in a couple of hours to see if spores are deposited on the paper. It may take from 2 to 24 hours to collect the spores.
6. Remove the glass or bowl and the cotton ball or paper towel. Carefully lift the mushroom cap up from the paper. You should now have a spore print!



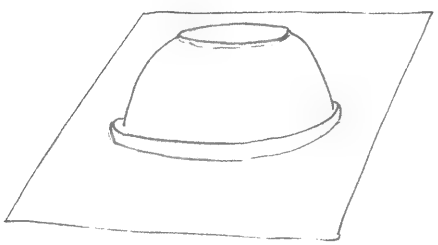
*remove the stem and place the cap right-side-up on a piece of paper*

To preserve you spore print once the paper is dry, spray it with clear acrylic, laminate it, or cover it with clear contact paper.

**Drawings by Carolyn Nixon of INHS.**



*the spore print, labeled with date and collection location*



*cover with a bowl or glass*

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Winter 2007
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INSIDE



# The Black-crowned Night-Herons of Lake Calumet Part I: Population Trends and Nesting Ecology


Black-crowned Night-Herons (*Nycticorax nycticorax*) are small, stocky herons which, as their name suggests, are most active during the late evening through early morning hours. They forage in a variety of aquatic habitats, feeding primarily on small fish and crayfish. Although Black-crowned Night-Heron (BCNHeron) populations have increased nationwide since the banning of DDT, Illinois has not enjoyed this recovery. The decline of the colonial-nesting BCNHeron as a breeding species in the state of Illinois has been documented by a number of authors. One of the largest remaining breeding colonies of this state-endangered species in Illinois nests in marshes adjacent to Lake Calumet in the south Chicago area. The Calumet region of southwestern Lake Michigan was once a vast complex of glacial lakes, wetlands, and sand prairies. This region is now one of the most heavily industrialized in the U.S., and has been greatly impacted by industrial activities, waste disposal and discharge, urbanization, and changes to surface and groundwater hydrology. In spite of extensive habitat loss and degradation, the area remains among the most biologically diverse in the state of Illinois. Consequently, key ecological features of the region are being rehabilitated, managed, and preserved according to the Calumet Ecological Management Strategy, the framework for the Calumet Open Space Reserve. The BCNHeron, a key species of conservation concern, annually nests in the area.

Young-of-the-year BCN-Herons were reported in the Calumet area as early as 1874. Throughout much of the early part of the 20th Century the Lake Calumet BCNHeron colony was located along the Calumet River just north of the confluence with the Grand Calumet River. The BCNHerons have nested at wetlands adjacent to Lake Calumet since the Thomas J. O'Brien Lock and Dam went into operation in the late 1960s. The number of BCNHerons nesting at these wetlands has fluctuated widely over the last two decades. The peak breeding population at Lake Calumet wetlands has varied, from a high of nearly 1,600 in 1992 to less than 600 in 2000. Although there was a declining population trend during much of the 1990s, numbers have been more or less stable at 600 to 800 breeding herons in recent years.

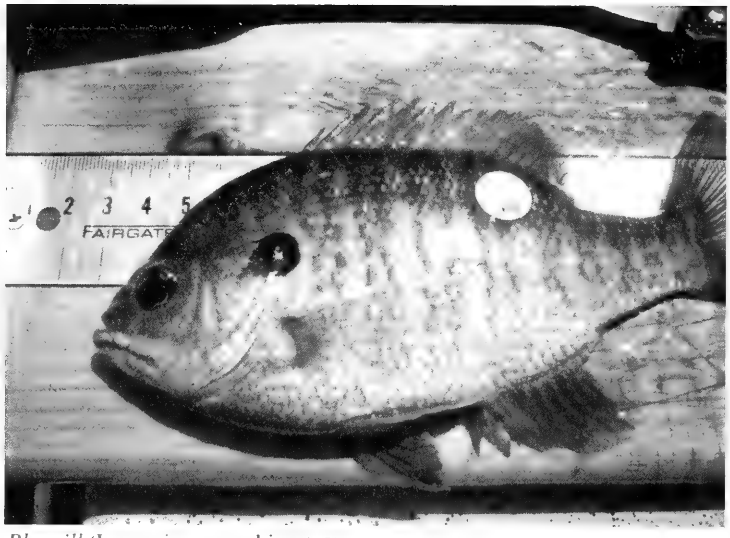
Most BCNHerons begin arriving at the Lake Calumet wetlands during the third week of March. Males soon begin nest building and displaying in an attempt to attract a mate. During the two years of this study

*Continued on back page*

# Bluegill as Homebodies: Do Males Display Fidelity to Nesting Sites?

Bluegill, *Lepomis macrochirus*, are common to warmwater lake and stream communities throughout Illinois and the Midwest. This, along with the bluegill's popularity as a recreational fishing species and the official designation of bluegill as Illinois' "State Fish," have motivated considerable interest in effective conservation and management practices, as well as increased our basic understanding of their reproductive biology.

Bluegill display a complex mating system, where males simultaneously congregate, sweep out, and defend depression-shaped nests in densely packed colonies—often exceeding 100 nests in some populations. These colonies, referred to commonly as "beds" by anglers and others, are built in a variety of substrate and cover habitat types within the shallows of lakes or ponds during the spring and summer breeding seasons. With the attraction and arrival of schools of mature females, nesting males display courting rituals to attract multiple females, both simultaneously and sequentially, to spawn in their nests. A male's spawning success is a direct reflection of the number of females he can attract to his nest—the more females he can attract and spawn with, the greater number of eggs he can fertilize and therefore increase his spawning success. After completion of a spawning bout within the colony—generally all within a single day—males remain alone to provide care for offspring. This care may last for several days to a week, depending on water temperature, to provide defense against nest predators (e.g., various minnows, bullheads, snails, and even neighboring or wandering conspecifics). Other forms of care include fanning and gleaning of the fertilized eggs until after the young hatch and eventually fledge as freeswimming young. Males may spawn multiple times throughout a year's spawning season and in subsequent years if they survive the winter.



*Bluegill* (Lepomis macrochirus). Photo by John Epifanio, Division of Ecology and Conservation Science

While a considerable literature has emerged on the evolutionary and ecological benefits of the parental care and anti-predator defense behaviors from colony breeding and male care in sunfish, little is known about how and where males choose to set up nests and colonies within a water body that is not limited by available spawning habitat. For the past three years,we have examined the levels and patterns of movement among males between reproductive bouts within and among breeding seasons. By individually marking and recapturing all nesting males, we have documented the fidelity of repeat-spawning males to areas within the lake at both coarse and fine scales. With the data we have obtained, we are addressing questions about the choices of colony location and social associations of males within a colony. More importantly, our data will permit us to examine whether location and social group choices are shaped by previous successful or unsuccessful reproduction.

*Bluegill egg masses.* Photo by John Epifanio, Division of Ecology and Conservation Science

The study site, Long Lake in eastern Ontario, is ideal for our research because it is a large and clear natural lake with restricted access and no known exploitation. The lake has a surface area of 29 acres and nearly 3 km of shoreline with numerous known and consistent areas for spawning. The lake also has sufficient shoreline complexity and areas that we could divide into four quadrants—two shallow bays at opposite ends of the lake and two side shorelines with interspersed shallows. The number of colonies observed in each quadrant has been

*Continued on page 5*

# Contaminants in Tree Swallows

The Calumet region of Chicago, Illinois, includes an extensive wetlands complex that has been severely degraded through heavy industrial activity, sewage and industrial discharges, landfills, and hazardous waste storage/disposal. Contaminant levels in sediment, soils, and terrestrial invertebrates are such that benthic macroinvertebrate communities, amphibian populations, insectivorous birds, and omnivorous waterfowl using this area may be at risk from exposure to polychlorinated biphenyls (PCBs) and metals. In areas such as these, species that are relatively tolerant of contaminants may serve as a source of food-borne toxicants to animals at higher trophic levels, including other invertebrates, fish, birds, and mammals. In the latter two cases, contaminants are moved from aquatic to terrestrial ecosystems, and scientists at the Illinois Natural History Survey, in conjunction with the Illinois Waste Management and Research Center, have been studying this exposure pathway using Tree Swallows (*Tachycineta bicolor*) as a model organism.

Tree Swallows are a useful monitoring species because they are common, aerial insectivores that readily colonize nest boxes, forage close to their nests, and are relatively tolerant of contamination. This lower sensitivity to the effects of contamination may allow them to persist and breed at sites where other, more sensitive species may not survive or reproduce. Furthermore, swallows tend to forage over open water, so their diet is often dominated by emergent aquatic insects that live or forage in and around the contaminated sediments during their larval stages. These qualities increase the value of Tree Swallows in monitoring the movement of contaminants from sediments to terrestrial ecosystems.

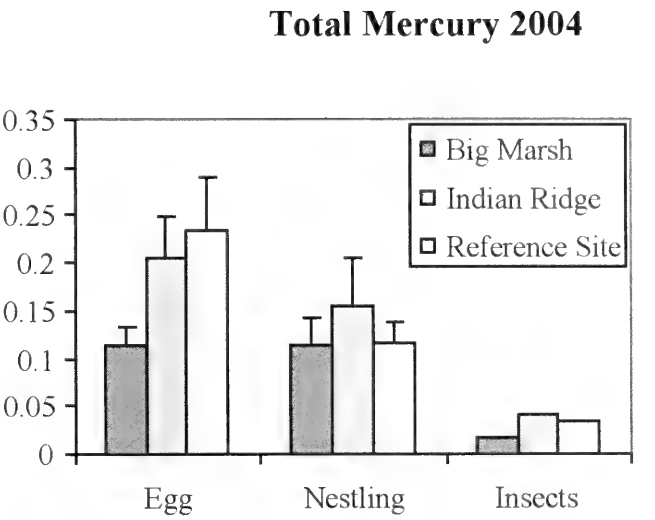



*Figure 1. Mean concentration of total mercury in the eggs collected from the Calumet sites.*

We collected sediments, larval aquatic insects, emergent adult aquatic insects, bolus (mass of insects that parent birds feed to young) material, and Tree Swallow eggs and nestlings at two polluted wetlands, Indian Ridge Marsh North and Big Marsh, and at a nearby reference site, Powderhorn Lake. We are measuring the concentrations of 14 metals, 14 organochlorine pesticides, and 30 PCB congeners in all the media collected. With this variety of media, we hope to determine the relative contributions of in ovo exposure and exposure via food from the local area to nestling contaminant loads. Moreover, we will estimate the contaminant exposure gained from a purely aquatic diet and we will determine the actual composition of their diet and quantify contaminants therein.

Mercury is a contaminant of particular concern in aquatic food webs because it biomagnifies and it is a potent neuro-toxicant, mutagen, and teratogen (causing fetal deformities). In our study, the eggs with the highest concentrations of mercury in both years were collected from our reference site, Powderhorn Lake (Fig. 1). Egg contamination represents the maternal burden of mercury passed on to the embryo, and the concentrations we are seeing may have been obtained by the mother on site, during migration, or from her wintering grounds.

*Removing a bolus (which includes an emergent aquatic damselfly) from a Tree Swallow nestling.*

Photo by Sue Gallo, Division of Biodiversity and Ecological Entomology

Our nest box monitoring data indicate that swallows start nesting significantly later at our reference site than at the other two sites, probably due to inferior physical habitat quality. Later nesting is well known to be associated with smaller brood size, and we have seen that these late nesters at our reference site lay significantly fewer eggs and have fewer young. These late nesters are also the birds that are passing on a higher mercury burden to their eggs. Although the concentration of mercury is not high enough to inhibit egg development, there may be some indirect reproductive effects on females in that they arrive later to the nesting ground and lay fewer eggs. It could also be that late arrivals migrate further and have higher mercury burdens, simply because of where they over-winter or the route they travel.

While the eggs at Powderhorn have the highest concentrations of mercury, the nestlings there acquired the least mercury from their diet, when you account for growth dilution (Fig. 2, page 5). Our 2004 samples of emergent aquatic insects do not yet explain this pattern. Further investigation into the swallows' diet with our analysis of boluses or our use of stable isotopes of carbon or nitrogen may shed some light on this by indicating differences in swallow feeding habits among sites. Since different

*Continued on page 5*

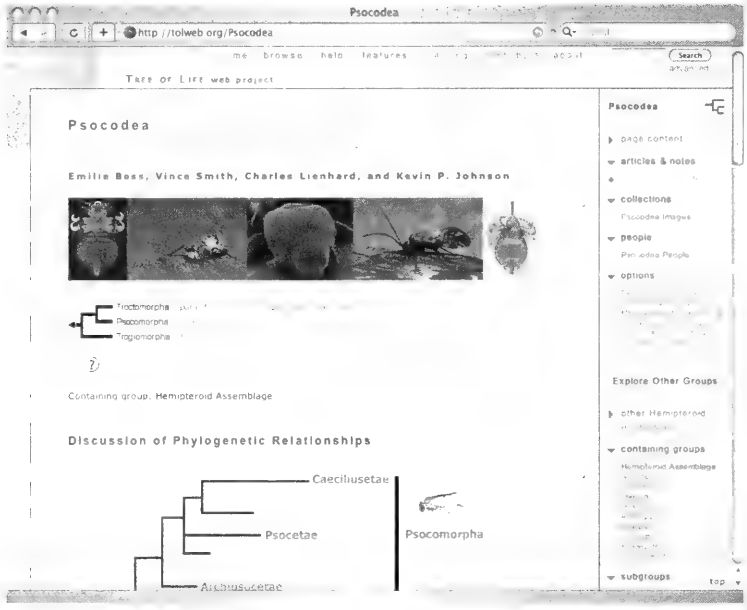
# The Tree of Life Web Project

How many species are there on earth? What are their names? What do they look like? How are they related to each other? The answers to these questions are scattered throughout many published papers on the taxonomy (naming species) and systematics (discovering evolutionary relationships) of plants, animals, fungi, and microorganisms. Because there are more than 1.5 millions species described, accessing and compiling this information in a comprehensive way can be very difficult and tedious. The Internet has the potential to bring together this information in a digestible form that can be easily accessed by anyone.

One project that addresses these questions is the Tree of Life Web project (tolweb.org), a National Science Foundation-funded project based at the University of Arizona. The Tree of Life targets an audience including professional scientists interested in biodiversity, students of all ages, and teachers who use the content in their classrooms. The goals of this project are 1) to provide a uniform framework in which to publish, electronically, information about the evolutionary history and characteristics of all groups of organisms, 2) to present a modern scientific view of the evolutionary tree that unites all organisms on earth, 3) to aid in learning about and appreciating biological diversity, and 4) to create a means to provide taxon-specific information on the Internet, both taxonomic and otherwise.

There are two types of Web pages in the Tree of Life project: branch pages and leaf pages. Branch pages contain information about higher groups in the tree of life, such as families or genera, and describe how these groups are related to each other. This information is based on the current state of systematic knowledge and usually integrates several studies regarding evolutionary relationships of these groups. Leaf pages highlight a single species and contain detailed information about its name, taxonomic authority, geographic distribution, images, bibliographic information, and whatever data the author of the page deemed relevant.

In its current state, however, the Tree of Life Web project is massively incomplete. There are only about 5,000 branch and leaf pages, a small fraction of the over 1 million described species on earth. Scientists at the Illinois Natural History Survey (Assistant Professional Scientist, Kevin Johnson and entomology graduate student, Emilie Bess) with colleagues at the Natural History Museum, London (Vincent Smith, former INHS post-doc), and Museum of Natural History, Geneva (Charles Lienhard), are working to triple the current number of pages by providing branch and species level coverage for two entire orders of insects: Phthiraptera (parasitic lice) and Psocoptera (bark lice). These two insect orders contain over 10,000 species, are closely related, and together form the group Psocodea, which could potentially be recognized as a single insect order.




*Sample page from the Tree of Life Web project.*

These researchers and colleagues have published several systematic papers (both molecular and morphological studies) about the evolutionary relationships of these insects. These studies are now being synthesized to describe the relationships among major groups within these two orders of insects. In cases where details of relationships have not been thoroughly studied, the most up-to-date and widely accepted taxonomic classifications are used to group species. The 10,000 bark louse and parasitic louse species pages will be generated automatically from electronic databases of two recent taxonomic catalogs of Psocoptera and Phthiraptera (INHS Special Publication # 24—*The Chewing Lice: World Checklist and Biological Overview*). Each species page will contain the species name, authority, geographic distribution, host association (for parasitic lice), and bibliography. Eventually, images, morphological descriptions, and ecological information can be added to these pages.

Participation in the Tree of Life Web project creates an accessible public presence for current work on two fairly obscure groups of insects. Through the Tree of Life, the names of all taxa of bark lice and parasitic lice will be searchable by on-line portals such as Google.com, and each page will contain a link to the Illinois Natural History Survey Web pages, highlighting the role of the survey in this initiative.

*Kevin Johnson, Division of Biodiversity and Ecological Entomology*

# Bluegill

*continued from page 2*

approximately equal in the three years we have studied the population (see Fig. 1).

A significant number and proportion of nesting males have been recaptured in subsequent spawning bouts within and between years (ranging from 19–23% within years from 2004 to 2006 and 12–17% between years). More importantly, spawning males recaptured within the same year displayed very high rates of fidelity at both coarse and fine scales (ranging from approximately 80–93% within quadrants within years and averaging greater than 85% at a scale of less than 100 meters of shoreline). Fidelity to social groups (i.e., repeatedly spawning with the same group of males) was considerably less.

*A snorkeler collects data on bluegill nesting.* Photo by John Epifanio, Division of Ecology and Conservation Science

The implication of these results is that males chose to renest at sites close to where they previously nested. This is not likely a simple matter of small home range, as individuals may move considerable distances between spawning bouts and during the nonbreeding season. Ongoing studies by our lab group and colleagues, including genetic profiling of adults and young, will provide additional insights as to whether reproductive success to fledging of free-swimming young affects decisions to return or abandon a location at coarse or fine scales. Moreover, our understanding of bluegill movement and spawning ecology will provide us the basis for more effective science-based management, especially as these relate to the effects of angling harvest on spawning beds and habitat disturbances that accompany shoreline or littoral zone development.

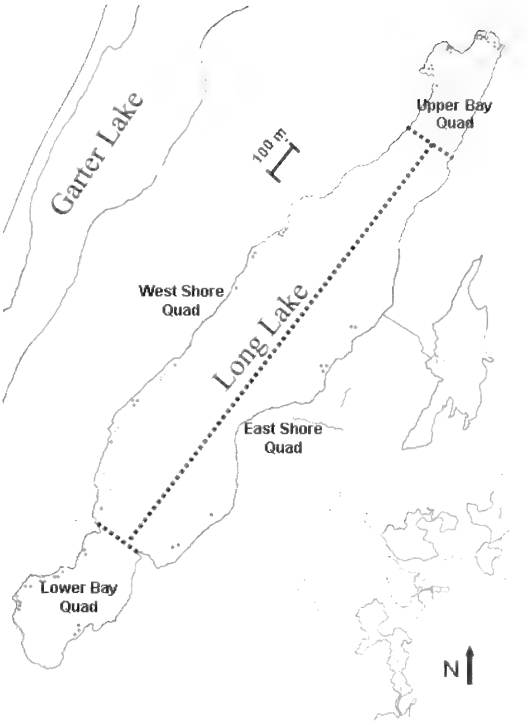



*Figure 1. Bluegill spawning sites within Long Lake. Dashed line indicates quadrant divisions. Dots are individual colonies with multiple nests that were marked in 2006.*

*Jennifer Bartlett, Natasha Silich, and John Epifanio, Division of Ecology and Conservation Science*

# Tree Swallows

*continued from page 3*

locations have different contaminant profiles, and some contaminants are more concentrated in higher trophic level insects, we hope to account for differences in nestling contaminant concentrations by identifying the amounts of terrestrial biomass and the differences in the trophic positions of their diet. Furthermore, these differences in diet should leave different isotopic signatures. Within the next six months, we hope to have all our swallow diet samples, contaminant results, and stable isotope results analysed. Then we will be able to draw some conclusions about risks to insectivorous birds in the Calumet region and whether different proportions of food of terrestrial or aquatic origin or different trophic levels greatly alter this risk.

*Sue Gallo, Dave Soucek, and Jeff Levengood, Division of Biodversity and Ecological Entomology*

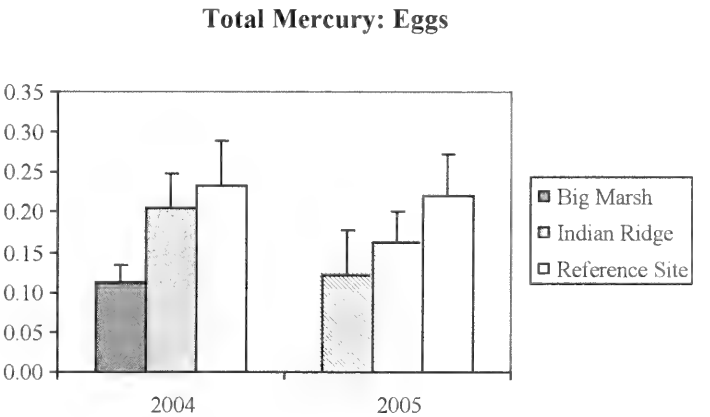



*Figure 2. Mean concentration of total mercury in the eggs, nestlings, and emergent aquatic insects collected from the Calumet sites in 2004.*

*Species Spotlight*

# Prairie Trout Lily

Susan Post

Location, location, location is everything in real estate. In botany, however, if not everything, it can often provide a definite clue to a plant's identity—a clue Charles Robertson should have considered when he was collecting in 1880. *Erythronium mesochoreum*, the prairie trout lily, looks like the white trout lily but grows in a different habitat. When it was first collected in Illinois on April 3, 1880 from Macoupin County near Carlinville, Robertson identified the specimen as the white trout lily (*E. albidum*), not taking into consideration the habitat where the plant was growing. One hundred years would pass before *E. mesochoreum* would be discovered again and Robertson's specimens correctly identified by Illinois Natural History Survey (INHS) botanists.

*The prairie trout lily* Erythronium mesochoreum. Photo by Susan Post, Division of Biodiversity and Ecological Entomology

During 1981, botanists from INHS, the Illinois State Museum, and the Illinois Department of Natural Resources observed and collected a trout lily on a prairie remnant in Macoupin County. They identified it as the prairie trout lily. Until this discovery, prairie trout lily was not recognized as occurring east of the Mississippi River. The closest occurring population was found in Pike and St. Louis counties of Missouri.

While the initial impression (both have singular white flowers with yellow stamens) may serve to confuse prairie trout lily with the woodland, white trout lily, there are several distinguishing characteristics. The prairie trout lily is a plant of the dry, southern tallgrass prairies and open oak woodland habitats. It occurs in southern Iowa, eastern Nebraska, eastern Kansas, Missouri, Oklahoma, and north-central Texas. It has an earlier blooming period—March through early April—in Illinois. The leaves are narrow, folded along their length, and usually lack speckling. In the white trout lily, the speckling of the leaves led to the common name trout lily, referring to their resemblance to the markings on a trout. The prairie trout lilly's fruit droops to the ground at maturity, whereas, in the white trout lily the fruit is held erect. The white trout lily produces runners that are usually covered by leaf litter, whereas, the runners are absent in the prairie trout lily. A final distinguishing character is that immature, single-leaved plants are infrequently found when the population is in flower. This is in marked contrast to the white trout lily, which can carpet the understory of woods with its leaves, while only a few blooms make their appearance.

The white trout lily is known from moist woods throughout Illinois. Prairie trout lily is known mainly from a few western locations in Illinois. Denby Prairie Nature Preserve in Macoupin County is one of the few sites where this plant may be observed.

**The Naturalist's Apprentice Teacher's Page**

Answers to *Anatomy of a Plant* on next page

a) bud; b) leaf; c) midvein; d) flowers; e) fruit; f) lenticels; g) stolon; h) roots; i) axilary leaf; j) stipule; k) node; l) stem; m) lateral roots; n) root hairs

# The Anatomy of a Plant

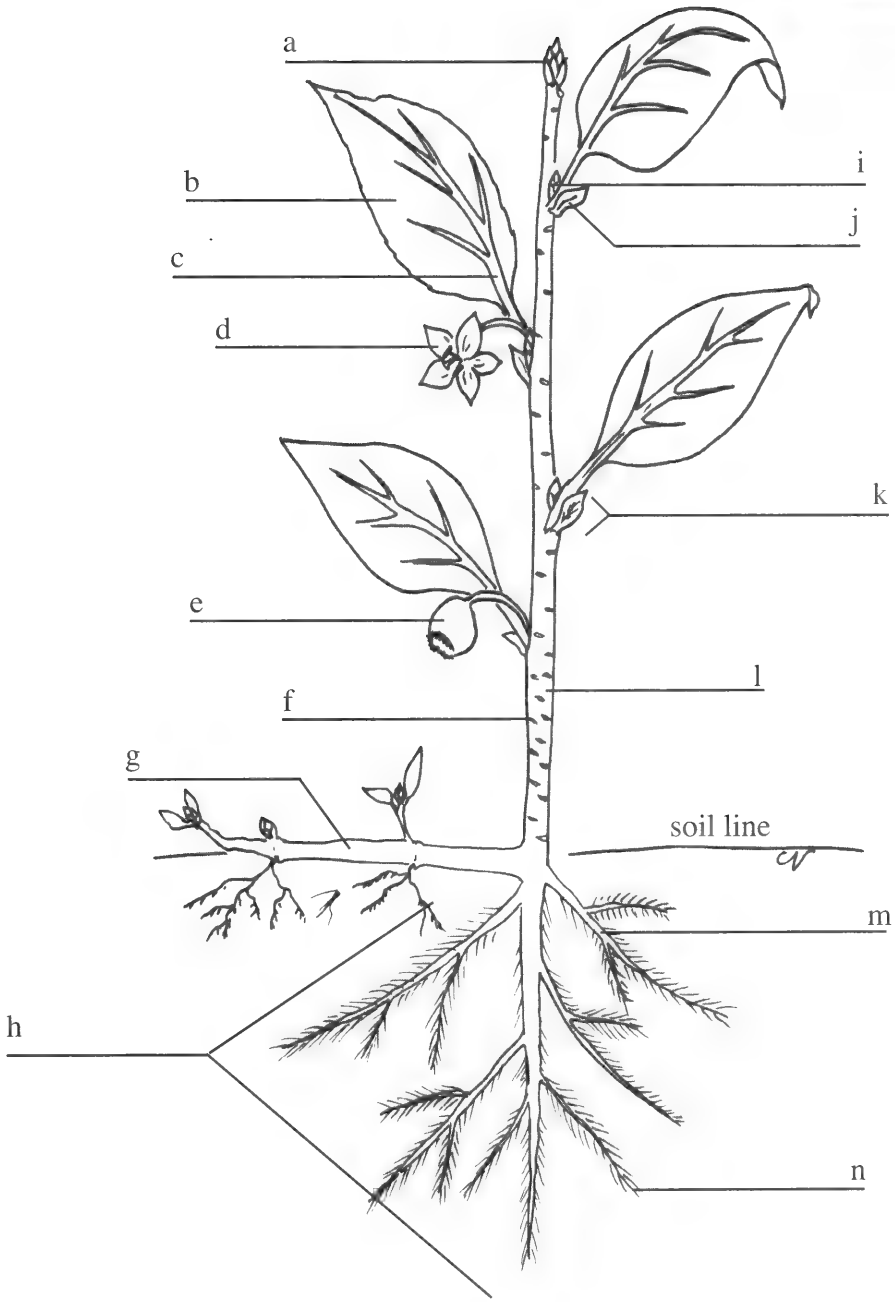
Carolyn Nixon

Anatomy of a Plant

el the plant parts on the diagram
g the terms that are in **bold**
ow.

main shoot of the plant is called
**stem**. The **roots** of the plant are
ow ground and help anchor the
t to the soil. The main root is
ached into several **lateral roots**,
these are often covered with very
**root hairs** that absorb water
nutrients from the soil. The
n often has many small, corky
ps called **lenticels**, which act as
es through which the plant can
hange gases with the atmosphere
athe). The main food producing
an of the plant is the **leaf**. The
e vein down the center of the
is called the **midvein**. The point
ere the leaf is attached is called
**node**. The structure that contains
young, developing leaves, which
ften covered with scales, is called
**ud**. There is often a small bud at
base of the leaf, against the stem.
s is the **axilary bud**. Some plants
o have a **stipule**, a small, leaflike
cture below the leaf attachment.
st plants reproduce by produc-
**flowers**, which, once fertilized,
duce **fruit** that contain seeds.
ne species also spread out from
original plant with **stolons**, which
stems that run along the surface
he ground and send down roots at
nodes.

wing by Carolyn Nixon,
HS Office of the Chief.



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Champaign, Illinois
61820 USA



# Night-Herons

*continued from front page*

the earliest indications of nest building and courtship occurred during the first week in April; the first pairs and precopulatory displays were observed during the second week of April in both years. The egg-laying period extended from the third week in April to late May or early June. Egg laying is asynchronous in this species, with eggs laid one to two days apart. This means that chicks differ in size and sibling competition is fierce; in most years only the two oldest chicks typically survive to fledge. The first eggs began to hatch in mid-May, and those first hatchlings are flighted about six weeks later. Juvenile dispersal may extend into late August in the Lake Calumet area, after which few BCNHerons remain in the natal wetland.

Emergent cover (giant reed *Phragmites australis*) was of primary importance for nesting during the period 1984 through 2003. BCNHerons constructed over-water platform nests in clumps of phragmites. Nests were constructed of last year's phragmites stems, sometimes lining the shallow nest bowl with purple loosestrife or other thin twigs. In some cases nests were flat enough to allow eggs to roll out into the water; this was the most prevalent cause of egg loss during our study. Since the bottom of the nest platform is typically located within a few centimeters of the water's surface, dramatic increases in water levels can threaten nests and cause adults to abandon the colony. Clusters of nests are often located on the edges of phragmites stands, with pairs sometimes nesting within less than a meter of one another. Great Egrets (*Ardea alba*) nested throughout the colony, often in close proximity to the BCNHeron nests.

Our nest-monitoring data indicated that reproduction in BCNHerons nesting at the north end of Indian Ridge Marsh, located adjacent to Lake Calumet, in 2002 and 2003 was typical for this species. In fact, the "recruitment" rate (number of young/nest surviving to 15 days) of 2.22 young/pair, observed in 2003, was among the highest ever reported. We also examined the various aspects of the foraging ecology and contaminant exposure of this colony. These topics will be addressed in Part II in the spring issue of this newsletter.

*Jeff Levengood, Division of Ecology and Conservation Science*

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Spring 2007
No. 391

INSIDE



# Will the Emerging Bioeconomy Add to the Burden of Invasive Species Management?

Modern prosperity and wealth are hitched to the petroleum wagon. From gasoline to polymers and plastics, petroleum provides most of our material needs. But such progress comes at a cost. Most noteworthy is global climate change from greenhouse gases produced by the use of fossil fuels. To mitigate human-induced climate change, the economy needs to reduce activities that add greenhouse gases to the environment. An important component of this change is the emergence of a *bioeconomy*, which in addition to food production includes the conversion of biological raw material (biomass) into biofuels like ethanol and biodiesel.

Using ethanol produced from plants is an environmentally friendly alternative to petroleum-based fuels. Currently, most ethanol is produced from fermentating sugars in plants. However, such production may be at odds with food production for humans and animals. Hence research is underway to produce ethanol from the major unexploited component of plant biomass—cellulose. This approach preserves the use of crops for food production and leaves leftover plant biomass for energy production. In addition, some plants are being considered primarily for biomass and biofuel production.

Some of the key species being considered for biofuel production are grasses, including switchgrass (native to the eastern and central U.S.), giant reed (native to Asia), reed canarygrass (native to temperate Europe, Asia, and North America) and miscanthus (native to Asia). Switchgrass, giant reed, and reed canarygrass reproduce vegetatively and from seed, while miscanthus only reproduces vegetatively. Extensive research is underway on the agronomic and energy production potential of these perennial grasses. In Illinois, switchgrass and miscanthus are being evaluated for bioenergy production.

While the opportunity to move towards biologically renewable fuel production is exciting, the plants under consideration are cause for concern. Giant reed and reed canarygrass have significant economic and environmental impacts due to their invasiveness in the U.S. Despite these known risks, energy firms are promoting giant reed for cultivation across 15,000 acres in Florida and 30,000 acres in Alabama. Some cultivars of switchgrass are strong competitors of native species in ecological restorations. Plants native in one region of the U.S. can become invasive when established in another. A well-known example of this is smooth cordgrass (*Spartina alterniflora*), a species native to the Atlantic coast that is currently a major invader of estuarine habitats on the Pacific coast.

Miscanthus is promising for its biomass potential and is therefore increasingly promoted

*Continued on back page*

Susan Post (INHS) stands in front of a field plot of miscanthus. The characteristics that enable it to be a boon for biomass production may prove to be a bane if it escapes cultivation and becomes invasive. Photo by Michael Jeffords, INHS Office of the Chief

# The Black-crowned Night-Herons of Lake Calumet Part II: Foraging Ecology and Contaminant Exposure

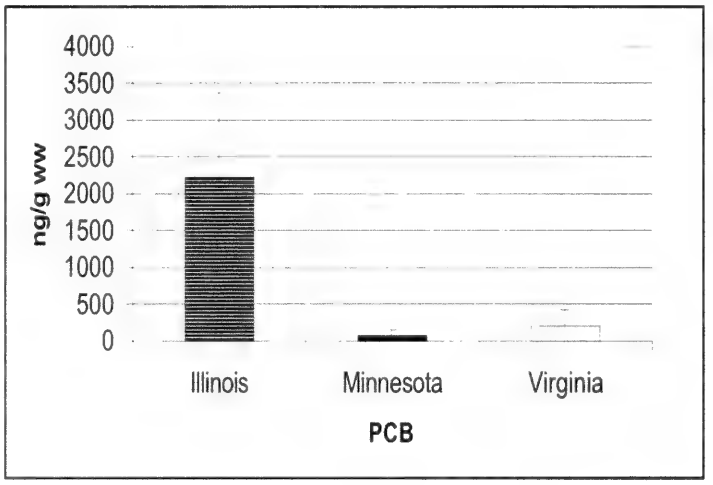
The Lake Calumet region south of Chicago was once a vast complex of glacial lakes, wetlands, and sand prairies. It has a legacy of intensive urbanization and heavy industrialization with associated problems of air, soil and water pollution, municipal and industrial waste disposal, and habitat loss and degradation. In spite of these issues, this area remains one of the most biologically diverse in the state. Key areas in the region are being rehabilitated and preserved according to the Calumet Ecological Management Strategy. Black-crowned Night-Herons (BCNHerons) are a key species of conservation concern there.

As part of a large study of state-endangered BCNHerons nesting in the area (see Part I in the Winter 2007 issue), we examined a suite of environmental contaminants and exposure endpoints in embryos collected in 2002 from colonies in Illinois, Minnesota, and Virginia. Their piscivorous feeding habits, plasticity in selection of nesting and foraging habitats, use of degraded habitats, colonial nesting behavior, and habituation to some forms of disturbance (e.g., vehicular traffic, trains) makes this species an excellent sentinel of environmental contamination in urban-industrial settings.

*Black-crowned Night-Heron hatchling.* Photo by Jeff Levengood, Division of Ecology and Conservation Science

Adult BCNHerons fed in waters throughout the south Chicago region, including those containing elevated concentrations of environmental contaminants. Beginning in April, increasing numbers of adults were observed along the Lake Michigan waterfront, where they apparently fed on alewife, a pelagic fish, on their inshore spawning run. Examination of food boluses regurgitated by nestlings revealed that a large proportion of the colony was indeed feeding on alewife. This forage species may be key to the persistence of such a large breeding colony in the Chicago area because it provides a superabundant food source during the critical time of feeding the young.

Total PCB concentrations in BCNHeron embryos




Embryos from the Lake Calumet, Illinois, colony had greater exposure to polychlorinated biphenyls (PCBs), 4,4'- dichlorodiphenyldichloroethylene (DDE, a degradation product of DDT), dieldrin, transnonachlor, oxyclordane, cobalt, copper, and selenium than did those from northwest Minnesota and coastal Virginia. Concentrations of PCBs and DDE, especially, were much greater in embryos from Illinois. Greater exposure of Illinois embryos to PCBs was reflected in increased ethoxyresorufin-*O*-deethylase and benzyloxyresorufin-O-dealkylase induction (EROD and BROD are cytochrome P450 monooxygenase enzymes involved in the biotransformation of organic molecules), and DDE was negatively correlated with eggshell thickness. However, measures of oxidative stress and genotoxicity were similar to those in embryos from the other colonies examined.

Although no overt effects such as embryo mortality or malformations were observed, Lake Calumet BCNHerons continue to be exposed to a variety of environmental contaminants. Hopefully, as efforts to clean up the south Chicago environment continue, such early exposures will no longer be a part of this species' life cycle.

This research was supported by the Illinois Waste Management and Research Center, the City of Chicago, and the Illinois Wildlife Preservation Fund.

*Jeff Levengood, Division of Ecology and Conservation Science*

# Establishment of Historic Fish Communities to Restored Illinois River Floodplain Lakes

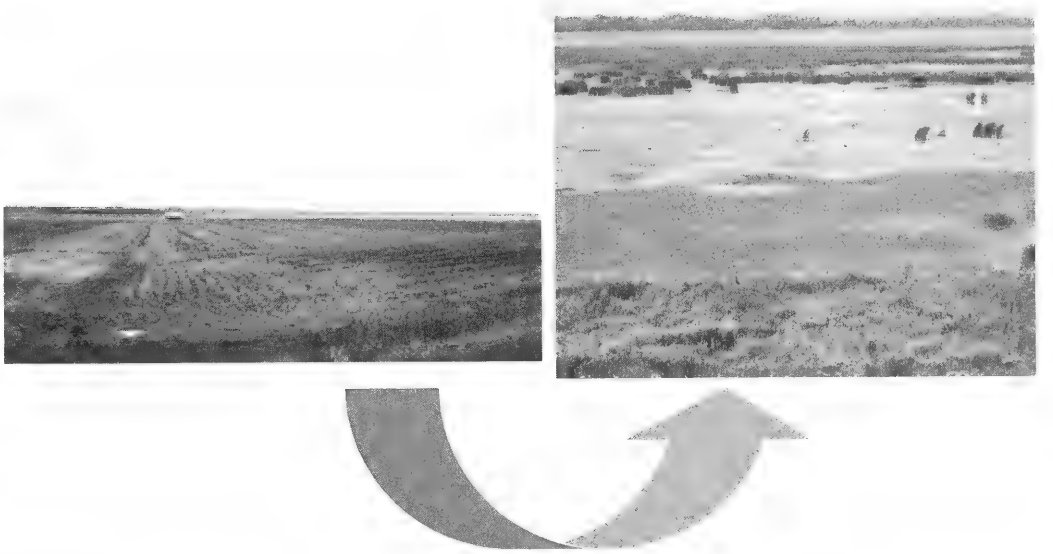
The Illinois River and associated floodplain lakes once possessed one of the most productive and diverse communities of fishes in North America. Most of the floodplains are now isolated from the river and drained, and consequently, fish populations and diversity have dramatically declined. A number of species that once flourished in the floodplain lakes have become rare or disappeared from the Illinois River valley. These include six of the state's threatened and endangered fish species such as *Notropis heterolepis*, the blacknose shiner and *Lepomis miniatus*, the redspotted sunfish.

Fortunately, tremendous effort and resources are being expended to restore large areas of the Illinois River and protect the river in general. The Wetlands Initiative and The Nature Conservancy are presently restoring three large floodplain areas along the Illinois River. The Wetlands Initiative is restoring the Hennepin-Hopper Lake system (Putnam County), and The Nature Conservancy is restoring Emiquon Preserve (Fulton County), and the Merwin Preserve at Spunky Bottoms (Brown County). This effort provides an excellent opportunity to restore a portion of the native fish community and aquatic ecosystem that has largely disappeared from most of Illinois. The total area of wetlands to be restored will be over 4,000 acres, some among the highest quality aquatic communities in the Illinois River valley.

Scientists and staff from the Illinois Natural History Survey, Illinois Department of Natural Resources, The Wetlands Initiative, and The Nature Conservancy are working to re-establish native fish species to these floodplain areas with funding from the U.S. Fish and Wildlife Service. Their goal is to begin in 2007 to introduce four to six native fish species to each of these areas along the Illinois River over a three-year period as part of the restoration of the aquatic communities.

There are several potential benefits to doing this project: (1) restoring a community that has largely disappeared from Illinois; (2) increasing populations of state-listed or rare species, which could lead to their delisting or prevent their being listed; (3) improving fish communities (and fishing potential) in general; (4) this project could be continued at each site with the eventual goal of introducing additional species; (5) it can be used as a model for the re-establishment of fish species in other areas in the Illinois River valley and the Midwest; and (6) training of graduate and undergraduate students as well as publishing the results for use by the scientific and conservation communities.

The project offers a number of challenges to successfully establish native fishes. Although there are potentially 25 fish species to be re-established, many of these are rare and will require care in gathering breeding stock for each lake. Also, selection of species for stocking requires that the species will fit well into the overall plant and animal communities. The lakes are large, (each over 1,000 acres), have fluctuating water levels, and contain potential predators. Refuge areas within the lakes will need to be created to give some species a chance to become established. Another big challenge is the presence of the common carp (*Cyprinus carpio*). This non-native species is associated with loss of aquatic vegetation and increased levels of water turbidity. Carp occur at all three sites and remain a threat to the stability and diversity of the sites. One stocking candidate is the bowfin (*Amia calva*). This voracious predator will be stocked and used in enclosure experiments at Hennepin-Hopper to determine its effectiveness as a native-species control on the carp. Ultimately, we hope that a highly diverse native fish community will add stability to the lakes and help resist factors like the common carp that threaten the aquatic communities.



From fields to restored habitats for fishes, bottomland fields are being returned to aquatic habitats along the Illinois River.

*Michael Retzer, Division of Ecology and Conservation Science*

# Endangered and Threatened Plant Species Database

As part of an ongoing and multifaceted effort to develop recovery strategies for Illinois endangered and threatened vascular plant species and the community types in which they occur, a computerized database of herbarium specimens representing all known Illinois collections of endangered or threatened species is currently under development. This database consists of information obtained from verified collections located at all Illinois herbaria as well as the herbarium of the Missouri Botanical Garden. Currently, there is no comprehensive compilation of data pertaining to collections of Illinois' rarest vascular plants and consequently no expedient way of accessing the invaluable information provided by these collections. A $20,000 grant to Loy R. Phillippe and Brenda Molano-Flores of the Illinois Natural History Survey by the Illinois Endangered and Threatened Species Protection Board allowed this database to undergo an extensive initial phase of development during 2005 and 2006.

Of the 2,165 vascular plant species (excluding hybrids and infraspecific taxa [subspecies, varieties, and forms]) native to Illinois, as described in the most recent flora of the state, 263 are listed as state endangered. Five of these are also listed as federally threatened, while one is listed as federally endangered. Seventy-five are listed as state threatened (two of which are also listed as federally threatened); and at least 83 are believed extirpated. One of these, *Thismia americana* N. E. Pfeiffer (American thismia), is believed extinct—having been known from one locality in Cook County and nowhere else in the world. In total, 3.8% of the state's vascular flora are believed extirpated and nearly 16% are listed as threatened or endangered—also facing potential extirpation. Exacerbating efforts to preserve plant communities that support these rare species as well as other uncommon plants are changes induced by phenomena including: 1) various forms of pollution, 2) the introduction of exotic organisms, 3) continued habitat loss, 4) habitat degradation, 5) anthropogenically altered herbivore activity, and 6) hydrological alterations. In order to further develop and refine recovery and protection strategies not only for plants/plant communities as well as the myriad of other organisms they support, it is vitally important to thoroughly understand the historic composition, structure, and location of vanished remnant communities and those which are still extant.

Figure 1. Herbarium specimen of *Lactuca ludoviciana* (western wild lettuce) collected by Robert Evers in Lake County, Illinois, in 1951. Photo by Michael Murphy, Division of Ecology and Conservation Science

For the initial phase of database development, specimen data from 2,232 specimens were obtained from 15 herbaria including the Chicago Botanic Garden (CHIC), Field Museum of Natural History (F), Illinois Natural History Survey (ILLS), Illinois State Museum (ISM), Illinois State University (ISU), Knox College (KNOX), Missouri Botanical Garden (MO), Northern Illinois University (DEK), Natural Land Institute (NLI), Rockford College (RCH), Southern Illinois University (SIU), The Morton Arboretum (MOR), University of Illinois (ILL), and Western Illinois University (MWI). The database consists of 26 searchable categories including plant family, genus, specific epithet, infraspecific epithet, date of collection, collector, collection number, accession number, current listed protective status, county, specific locality within county, township/range/section, latitude/longitude, habitat, and the herbarium at which a given specimen is located.

Figure 2. Herbarium specimen of *Woodwardia virginica* (Virginia chain fern) collected by George Fuller in Lake County, Illinois, in 1944, the same year it was discovered in this tamarack bog habitat. Photo by Michael Murphy, Division of Ecology and Conservation Science

When complete, scientists at various state, federal, and other institutions will have access to an extremely comprehensive and searchable database that includes data from the earliest as well as most recent collections of Illinois' rarest vascular plant taxa. In light of the fact that nearly 20% of our native flora is either extirpated or threatened with extirpation, these data will supplement our research, conservation, and management efforts in identifying and preserving remnant natural communities—communities that represent a vital component and foundation of our remaining natural heritage.

*Michael Murphy, Division of Ecology and Conservation Science*

# Exploring the Potential Influence of Fish Diversity as a Determinant of Ecosystem Properties in Aquatic Food Webs

Ecologists have long been interested in how abiotic and biotic forces structure communities. An important issue receiving a lot of attention lately is the bi-directional relationship between communities and ecosystem processes; specifically, how and when does biodiversity govern ecosystem function through species traits and interactions. Dramatic changes in biodiversity have made research linking community and ecosystem processes particularly relevant. Thus, researchers are exploring how changes in species composition, distribution, and abundance influence ecosystem properties.

Species matter beyond their aesthetic, cultural, and economic value because individual species and their interactions can help maintain ecosystem processes. For instance, when a species goes extinct there is a loss of the ecosystem processes contributed by that particular species. Even small shifts in species composition or species richness could translate into large effects on ecosystem properties. Therefore, understanding the functional consequences of changing community structure and the underlying mechanisms are critically needed, especially when coupled with intensive land use and human transformation of natural systems.

Studies exploring biodiversity as a determinant of ecosystem function are sparse in freshwater systems, even though biodiversity has been dramatically altered in aquatic systems from species invasions and extirpations. These dramatic changes in biodiversity have been occurring in fish communities with economic and ecological impacts. Both recreational and commercial fisheries have large economic effects. From a basic ecological perspective, examining fish diversity is important due to their ability as consumers to modify linkages between biodiversity and ecosystem function through trophic interactions. Fish community differences may alter the structure of lower trophic levels, changing the transfer efficiency of energy through the food web. The potential importance of trophic cascades in freshwater systems can be used for management and bio-manipulation.

Fish communities in Illinois and across the U.S. have experienced many extirpations and introductions. In the U.S., introductions have had the largest effect on the homogenization of fish faunas with over 22 species of fish listed in Illinois. There are also currently 18 endangered and 13 threatened fish species in Illinois. The dramatic changes to aquatic communities in Illinois, combined with the intensive land use and human transformation of natural systems, make research on the effects of changes in biodiversity to ecosystem function essential.

Figure 1. Spatial scales used to assess how biodiversity influences ecosystem function (left to right: mesocosm tanks, experimental ponds, and lakes).

**Methods.** We are testing the relationship and potential mechanisms for fish diversity to govern ecosystem properties. We are examining response variables of productivity, temporal variability, nutrient status, and zooplankton dynamics across spatial scales of mesocosm tanks at the Illinois Natural History Survey (INHS) Kaskaskia Biological Station, experimental ponds at the INHS Sam Parr Biological Station, and Illinois lakes. In tanks and ponds, fish richness treatments range from 0–6 species created randomly from a species pool of bluegill sunfish, redear sunfish, golden shiner, young-of-year largemouth bass, red shiner, and fathead minnow. Fish species are from a range of insectivorous fish with differing morphologies, behaviors, habitats, and foraging preferences creating a gradient of characteristics to tease apart the governing influence of fish richness.

A Grant-In-Aid of Research from the National Academy of Sciences, administered by Sigma Xi and the NSF Doctoral Dissertation Improvement Grant, has provided support for the tank and pond experiments. The relationships between fish diversity and ecosystem properties are being tested in 32 lakes (surface area: 25.2–11,000 acres) distributed across Illinois. These lakes serve as natural experiments since fish species composition is under intensive management and the lakes are of a known similar age. Fish communities and ecosystem properties have been monitored seasonally since 2003. Species richness and identity will again be analyzed for their effects on ecosystem properties.

**Preliminary Results.** Patterns and mechanisms vary for different components of the food web. A dominant species, bluegill sunfish, is the primary mechanism driving fish productivity. Thus far, zooplankton richness is driven by fish species composition, while zooplankton density appears to be driven by resource complementarity. Chlorophyll-a and total phosphorus are influenced by multiple mechanisms that need to be investigated further.

**Next step.** We are currently testing how the ability of biodiversity to govern ecosystem function interacts with the invasion of the exotic species common carp. Local biodiversity represents an important line of defense against the spread of exotics and has the potential to buffer the effects of invasive species. These studies will improve predictions for conservation and management actions in response to changes in biodiversity from species invasions.

*Michael P. Carey and David H. Wahl, Division of Ecology and Conservation Science*

*Species Spotlight*

# Spring Ephemerals

Susan Post, Jim Sternburg, and Jim Wiker

The term "spring ephemeral" evokes trips to the woods to see an ever-changing palette of favorite spring wildflowers. But have you ever thought of ephemerals in terms of butterflies? While we are used to seeing swallowtails, morning cloaks, cabbage whites and the first monarch of spring, we know we will continue to see them throughout the spring, summer, and even into fall. But what about those butterflies that are out for only a few short weeks each spring? Illinois has 10 species that appear and disappear like the blooms of a bloodroot. And like the petals of a bloodroot blossom, inevitably carried away by spring winds, these butterflies only make brief appearances each Illinois spring.

Two species, the falcate orangetip and the Olympia marble, belong to the butterfly family Pieridae and are related to the ever-present cabbage white and the orange sulphur.

Olympia marble butterfly. Photo courtesy of James Sternburg, University of Illinois

### Falcate Orangetip—*Anthocharis midea*

Spring has arrived in southern Illinois when one sees the orangetips visiting toothwort (*Dentaria* spp.). The falcate orangetip is one of the true harbingers of spring, flying through the woodlands only a few feet above the ground and seemingly never stopping. Once they alight, they are very approachable and can be studied at length by the careful observer. The male gives the species its common name as it has bold orange tips on its sickle-shaped (falcate) forewings.

Orangetips prefer wet, open deciduous forests in succession, especially those with young trees and plenty of small open areas. Both sexes bask frequently, especially early in the day. Males set up territories and patrol for females during the late morning and early afternoon. Females lay only one egg per plant either on the developing leaf or flowering buds of rock cress (*Arabis* spp.), winter cress (*Barbarea* spp.), and other mustards. The larvae feed on buds, flowers, and seedpods and pupate on sticks and branches near the dying host plants.

Look for orangetips in April at your favorite wildflower haunt in southern Illinois.

Male falcate orangetip butterfly. Photo courtesy of James Sternburg, University of Illinois

### Olympia Marble—*Euchloe olympia*

The Olympia marble is found in prairie remnants, savannas, and sand dunes—dry sandy areas. In Illinois they fly from April to May and we have two forms —the Great Lakes form, which is smaller and flies well into May, and the regular form. The common name comes from the marblelike pattern on the underside of the hindwing.

Males stake out hill-top locations or elevated sites and patrol just a few feet above ground. Their flight is rapid and direct. Females will deposit their eggs on unopened flower buds and flowers of rock cress (*Arabis* spp.). The larvae eat the flowering parts and seedpods of their hosts. The butterfly overwinters as a chrysalis.

Look for this species in spring at Sand Ridge State Forest on *Arabis* spp. or cleft phlox. They may also be found in the dry hill prairies along the Illinois and Mississippi rivers.

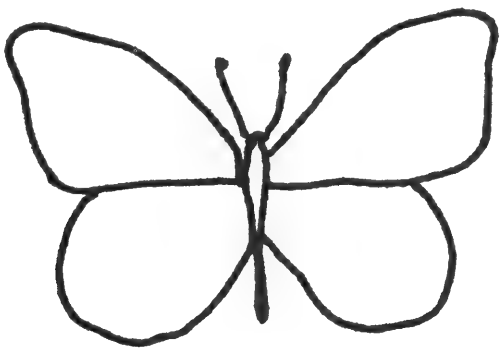
## Field Marks for Identifying Illinois Butterflies

Like birding, butterfly watching requires that we be able to identify butterflies in the field. Also like birds, butterflies have certain field marks that can be used for identification. For example, a viceroy differs from a monarch by the presence of a black line running diagonally across its hind wing. Learning these characteristic field marks can be a tedious chore, especially on very similar species such as the hairstreaks.

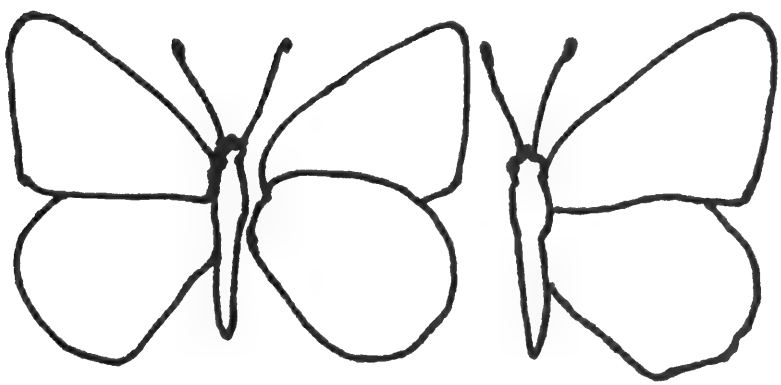
Start your own field guide by coloring the checkered white and the falcate orangetip drawings shown below. Find a picture in a field guide to copy the colors and markings.

To aid you in your studies, general outlines of all the butterfly species that have been found in Illinois can be downloaded at www.inhs.uiuc.edu/chf/outreach/downloads/ButterflyColoringShapes.pdf. They are for you to create your own field guide of distinguishing marks that will help in your butterfly identification. Note that the outlines are not to scale, and that mostly the upper surface (left side) and lower surface (right side) of the wings are featured. In a few instances, both male and female wings are shown. Using a copy of the *Field Guide to Butterflies of Illinois* by John K. Bouseman and James G. Sternburg, find those butterflies that have been discovered in your area, or in an area which you are going to visit. Copy them from the downloaded page, and color them. You will have a field guide to your special area of Illinois.

Jotting down characteristics or actually drawing in these field marks will help you remember them and heighten your enjoyment of butterfly viewing.



Falcate Orangetip. Drawing by Michael Jeffords, INHS Office of the Chief



Checkered White. Drawing by Michael Jeffords, INHS Office of the Chief

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# Bioeconomy

*continued from front page*

as *the* grass for biomass production. However, its invasiveness is unknown. Based on 20–30 years of European experience, it is argued that it poses a low risk. However, evidence from analysis of the invasion history of exotic plant species suggests that many exotic species "lie low" for several decades (hence labeled "sleeper weeds") prior to becoming invasive. The invasiveness of miscanthus may indeed be low, but at present the evidence to evaluate this is scant. It is important to remind ourselves of the scientific caveat that "the absence of evidence is not evidence of absence."

To avoid competition for prime agricultural land between food and biofuel crop cultivation, some proponents are advocating the use of marginal and Conservation Reserve Protection (CRP) land—even riparian buffers as potential regions where biofuel crops can be grown. This causes concern for at least two reasons: (a) it places these species on land prone to erosion adjacent to pathways of dispersal, which may cause them to easily spread through the landscape and (b) it could potentially lead to a reduction in diversity of these ecosystems, and related loss in ecosystem function.

Many of the characteristics deemed ideal in a biofuel crop are similar to those in invasive species. So we must adopt a precautionary approach and subject each candidate biofuel species to stringent, quantitative risk-benefit analyses. Only such analyses will help balance the relative benefits, costs, and risks of different species and identify habitats where such risks are likely to have consequences. Such research is underway at the Illinois Natural History Survey.

The emerging bioeconomy is rich with opportunities for addressing several contemporary regional and global environmental issues. In seizing these opportunities we must be cognizant of the potential problems outlined above. To move our hitch from the petroleum wagon to the new bioeconomy wagon without addressing these issues will only add to the burden of invasive species management.

*S. Raghu, Division of Biodiversity and Ecological Entomology*

Illinois Natural History Survey Reports is published quarterly by the Illinois Natural History Survey, 1816 South Oak Street, Champaign, IL 61820. Headquartered on the campus of the University of Illinois at Urbana-Champaign, the Survey is a division of the Illinois Department of Natural Resources.

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ILLINOIS NATURAL HISTORY SURVEY Reports

Summer 2007
No. 392

INSIDE



# Diseases of Beneficial Insects

Recent reports of the disappearance of honey bees attributed to a mysterious disease called "colony collapse disorder" have brought many issues to the public eye concerning, among others, the importance of beneficial insects, the global movement of both insects and their diseases, and the impacts of species loss on human activities and health. Not all insects are pests, nor are all diseases detrimental—many disease organisms are used in control of pests and all are part of the natural cycle of animals. But diseases in insects we depend upon are not always well understood and may be devastating to agriculture and the natural environment.

Honey bees are the most easily manipulated of the world's pollinating species and, therefore, the most intensively studied. Even with an extensive knowledge base concerning their pathogen/parasite complex, researchers and producers still are faced with unexpected epizootics and introductions, and the bee industry is constantly focused on identifying, treating, and avoiding various natural enemies that threaten its livelihood. For example, in addition to the recent colony collapse disorder and varroa mite infestations, a microsporidian pathogen, *Nosema ceranae*, previously thought to occur only in the Asian honey bee, *Apis cerana*, has now been found to occur worldwide in colonies of *Apis mellifera*, the European honey bee.

*The bee team (L–R): Jamie Strange, Terry Griswold, Sydney Cameron, and Lee Solter.* Photo by Joyce Knoblett

Bombus griseocollis *foraging on purple coneflower.* Photo by Lee Solter, INHS

Like all other animals and plants, insects are victims of many different types of diseases, viruses, bacteria, fungi, protozoa, and nematodes. Disease organisms of any or all of these groups are found in any well-studied host species. Like other natural enemies, diseases are important in maintaining insect populations at levels that are actually optimal for the species, preventing populations from outstripping their own food supplies. In terms of human interactions with insects, we would be much worse off if insects such as mosquitoes, blackflies, house flies, and agricultural pests did not succumb regularly and in great numbers to diseases. There are, however, insects such as bees and silk worms, predatory flies and beetles, and other managed beneficial insects that benefit humans, and there may be serious consequences when they are devastated by epizootic diseases.

The Insect Pathology Program at the Illinois Natural History Survey partners with federal, state, and university cooperators to study diseases of both pest and beneficial insects. Some of the more recent research projects have dealt specifically with beneficial species. One project involves working with the USDA Forest Service to identify and mitigate the occurrence of disease in several species of beneficial beetles that are being used for biological control of the hemlock woolly adelgid. This Asian adelgid pest is devastating populations of eastern and Carolina hemlocks in both horticultural

*Continued on back page*

# Developing a Regional Monitoring Plan for Chicago Wilderness

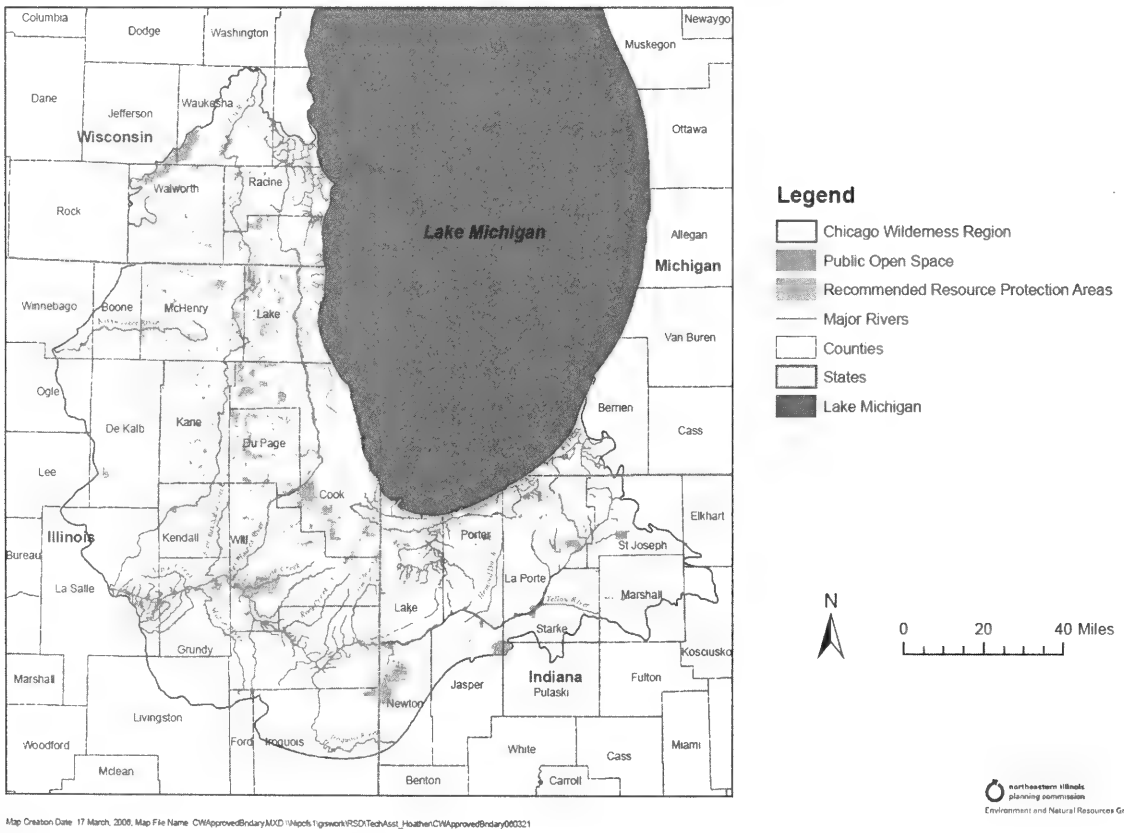
The Chicago Wilderness consortium is an alliance of more than 200 public and private organizations working to protect, restore, study, and manage the natural ecosystems of the Chicago region; contribute to the conservation of global biodiversity; and enrich local residents' quality of life. Since its founding more than 10 years ago, the consortium has recognized that monitoring throughout the region is needed to assess the status and trends of natural communities, which cover more than 225,000 acres. Reaching agreement among the consortium members on what should be monitored has proven difficult, however.

About two years ago, Chicago Wilderness asked the Illinois Natural History Survey (INHS), a charter member of the consortium, to coordinate efforts to develop a regional monitoring plan. The survey has a long history of monitoring the natural resources of Illinois. A prime example of the survey's efforts is the Critical Trends Assessment Program, which has been monitoring trends in major natural communities around the state for more than 10 years. The survey's charge is to develop a scientifically sound monitoring program that reflects the consortium members' priorities. This effort has been led by Dr. Geoff Levin, director of the survey's Division of Biodiversity and Ecological Entomology.

The process of developing a regional monitoring plan began with a two-day workshop that brought together representatives of many of the consortium's members. Through a series of facilitated discussions and breakout sessions, we agreed that the two major questions to be addressed through monitoring are 1) what is the health of the region's natural communities and how is that changing over time, and 2) what impact is management having on natural community health. Workshop participants also agreed that all natural communities in the region should be monitored, but that special attention should be given to rare or endangered plant communities and animal species assemblages. In addition, the group recommended that regional monitoring build on monitoring already being undertaken by consortium members, insofar as those efforts can be integrated.

Following the workshop, the survey spent many months interviewing consortium members to determine what monitoring they currently are doing. (This step has focused on terrestrial systems; a separate effort led by the Chicago Wilderness Aquatics Taskforce is looking at aquatic monitoring.) Most monitoring is being done by governmental agencies, especially forest preserve districts, the Illinois Department of Natural Resources, and volunteer groups. A wide

**The Chicago Wilderness Region**

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*Continued on page 5*

# CTAP: 10 Years and Going Strong!



*The Changing Illinois Environment: Critical Trends*, a state-of-the-environment report published in 1994 by the Illinois Department of Natural Resources concluded that habitats in Illinois were deteriorating as the result of habitat fragmentation and biotic/abiotic stressors. This report recommended that the state begin collecting statewide data on both the current conditions and future trends in these habitats. Since 1997 the scientists of the Critical Trends Assessment Program (CTAP) have undertaken this task.

CTAP is a long-term habitat monitoring program that samples habitats across Illinois. It is sponsored by the Illinois Department of Natural Resources (http://dnr.state.il.us/) and housed at the Illinois Natural History Survey (http://www.inhs.uiuc.edu/). The goal of CTAP is to gather baseline data on the biological health of our forests, wetlands, grasslands, and streams, and to determine how these habitats are changing through time. This information supports efforts to better understand, conserve, restore, and manage Illinois forestlands, wetlands, grasslands, and streams.

Over the last 10 years the program has surveyed 176 grasslands, 175 wetlands, 177 forests, and over 150 streams (Figure 1). We have sampled sites in all 102 Illinois counties, identified over 1,270 species of plants, and found 202 species of birds. The program has produced 31 regional assessments reports for watersheds throughout Illinois to inform local conservation work. These data are increasingly relied upon by public and private institutions throughout Illinois and even across North America to inform their decision making. For example, the CTAP Web site (http://ctap.inhs.uiuc.edu) has received over 1.3 millions hits in only a few years.

CTAP has accumulated the data to quantify the state of natural and semi-natural habitats throughout Illinois; it is now poised to address ecological trends through time—changes in the future.

Some typical questions that can be addressed with these time-series trend data are:

a) How will the arrival of the emerald ash borer affect Illinois forests?

b) What effect is global climate change having on Illinois's flora and fauna?

c) Which invasive species are most common or problematic, and which are spreading the fastest?

d) Are macroinvertebrates and aquatic life re-colonizing streams with improved water quality?

e) To what extent are oak-hickory forests becoming sugar-maple forests?

f) How are changes in surrounding landuse affecting flora and fauna?

*Continued on page 5*

***Critical Trends Assessment Program Fact Sheet***

- We have randomly sampled forests, streams, wetlands, and grasslands for the past 10 years throughout Illinois (Figure 1).
- 176 grasslands surveyed (14 considered high quality for plants)
- 175 wetlands surveyed (28 considered high quality for plants)
- 177 forests surveyed (26 considered high quality for plants)
- >150 streams surveyed (30 considered high quality)
- Sites in all 102 Illinois Counties (Lake County has the most sites with 22)
- Of the 528 sites we have surveyed 401 were privately owned and 127 were publicly owned
- 1270 plant species have been identified (1035 native and 235 introduced species)
  - 241 "sensitive" species
  - 42 "problematic" species
  - 11 state endangered species
  - 3 state threatened species
  - 1 federally endangered
- 202 bird species have been identified
  - 7 state threatened species
  - 18 state endangered species
  - 1 federally threatened species
  - 1 federally endangered species
- Produced 31 watershed assessment reports
- 4 peer-reviewed publications have been produced
- >20 presentations at scientific meetings
- >30 presentations at local meetings
- 1.3 million hits on the CTAP website (http://ctap.inhs.uiuc.edu/)
- A conservative estimate of 2,700 people contacted to obtain access to both private and public sites.
- Landowners are provide with a list of bird and plant species found on their properties as well as management and conservation information upon request
- Participated in and trained volunteers for River, Forest, and Prairie watch
- Provided information or advise to numerous organizations
  Examples:
  - –U.S. EPA
  - –SIU - Carbondale
  - –Wisconsin DNR
  - –Heinz Foundation
- 3 botanists (C. Carroll-Cunningham, J. Ellis, G. Spyreas)
- 2 ornithologists (S. Bailey, R. Jack)
- 1 stream ecologist (Dr. E. DeWalt)
- 1 coordinator (Dr. M. Ward)

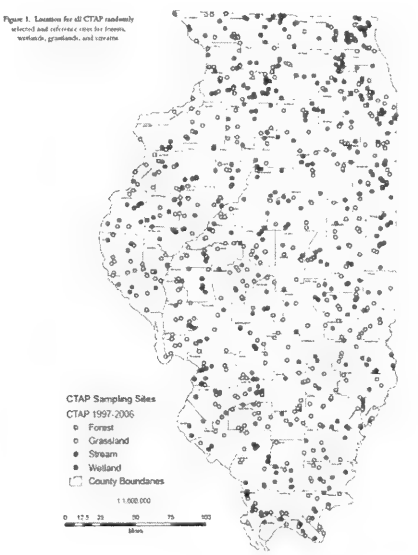


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*Figure 1. CTAP Fact Sheet.*

# Frequency of Early Mortality Syndrome in Southwestern Lake Michigan Lake Trout Populations

Self-sustainable lake trout, *Salvelinus namaycus,* populations in Lake Michigan are a primary but unmet goal of the fisheries managers in the region. Large numbers of hatchery-origin lake trout are stocked into Lake Michigan every year. Although these fish survive well to adulthood and produce viable eggs, no significant natural recruitment has been recorded. Poor lake trout recruitment in various systems has been linked with insufficient broodstock, diminished spawning habitat, contaminants, predation on eggs and alevins, and nutritional deficiencies. However, no clear cause for lack of natural recruitment has been identified for Lake Michigan lake trout. Nutritional deficiencies associated with inadequate levels of thiamine (vitamin $B_1$) in the eggs result in high mortalities of yolk sack stages of several salmonid species in the Great Lakes and in the Baltic Sea. Mortality caused by thiamine deficiency, commonly referred to as Early Mortality Syndrome (EMS), is a consequence of high levels of thiaminase, an enzyme degrading thiamine, found in prey fishes such as alewife, *Alosa pseudoharengus*, and rainbow smelt, *Osmerus mordax*. Because alewives are a major component of the lake trout diet in Lake Michigan, we hypothesize that EMS may be a significant bottleneck in the survival of early life stages of this species.

The Illinois Natural History Survey, with collaborators from USGS Great Lakes Science Center and the Ohio State University, is investigating individual variation in thiamine levels in the eggs of Lake Michigan lake trout at the time of spawning (picture). Eggs are fertilized, incubated, and hatched under controlled laboratory conditions. High performance liquid chromatography (HPLC) is used to determine concentrations of vitamin $B_1$ in the eggs. Finally, we quantify mortality caused by EMS in young lake trout and correlate it with levels of thiamine found in eggs from individual females.

Results to date indicate that egg thiamine concentration varies by an order of magnitude among investigated females. More than 50% of all females sampled produced eggs with free thiamine levels below 0.8 nmol/g. In laboratory experiments, EMS frequency soared dramatically among lake trout offspring hatched from eggs containing free thiamine below this threshold (Fig. 1). Post-hatch mortality attributed to EMS occurred between 700 and 900 degree-days, an age at which lake trout offspring are swimming and actively looking for food.

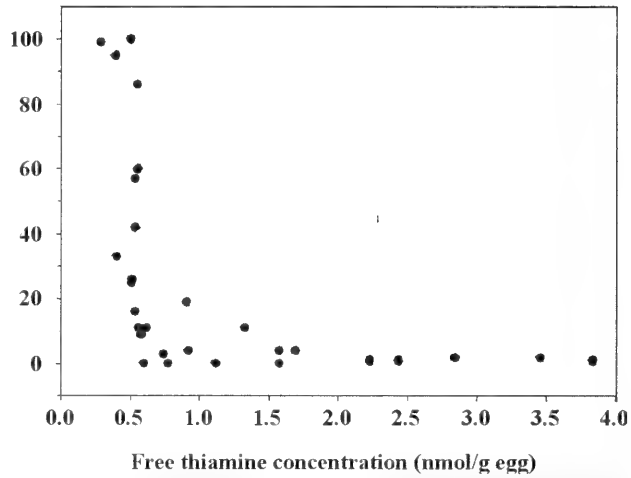


*Figure 1: Relationship between free thiamine concentration in unfertilized, ovulated lake trout eggs and EMS-related mortality in the offspring.*

Understanding the potential importance of EMS as a regulator of lake trout reproductive success is critical for the effective management of this native Lake Michigan fish. These findings extend our ability to interpret the role of EMS in the lake trout recruitment dynamics. For instance, the actual number of spawning lake trout needed to generate natural reproduction in Lake Michigan may be underestimated by 50% or more once losses associated with EMS are taken into account. Because of the possible benefits of our findings for managers, it is essential to investigate lakewide variability of thiamine deficiency as well as the importance of EMS compared to other sources of early mortality among Lake Michigan lake trout.

*Collection of lake trout eggs.* Photo by Sergiusz Czesny, Division of Ecology and Conservation Sciences

*Sergiusz Czesny and John M. Dettmers, Division of Ecology and Conservation Sciences; Konrad Dabrowski, TheOhio State University; and Jacques Rinchard, USGS Great Lakes Science Center*

## Chicago Wilderness

*continued from page 2*

variety of plant and animal groups are being monitored, but most data are being gathered on plant communities and birds. In addition, threatened or endangered plants and animals are being monitored fairly extensively. Unfortunately, integrating much of this information into a regional monitoring effort will not be possible. Protocols vary widely among existing monitoring programs, making it difficult to compare their results. Most monitoring locations are selected to answer specific questions rather than being randomly distributed, or are maintained in a variety of formats, including paper files, making it difficult to bring the data together.

Because regional monitoring of terrestrial ecosystems will have to be based largely on newly collected data, it will be important to focus on efficient approaches. Following discussions with experts from within the survey and meetings with consortium members, tentative agreement has been reached to focus initially on plant communities, birds, and turtles. Other organisms either are extremely difficult to identify accurately or do not provide as much information about general ecosystem health. Randomly selected sites will include both managed and unmanaged sites, allowing assessment of both ecosystem health and management effects. The plan will also recommend that Chicago Wilderness encourage expansion of existing successful programs that monitor butterflies, frogs, and threatened and endangered plants. INHS staff currently are finalizing detailed monitoring protocols, methods for selecting monitoring sites that provide a random and representative sample, and recommendations for data management and analysis. A draft plan will be presented to consortium members at a meeting later this year and then revised in response to their input.

A pilot project to monitor plant communities will take place this summer under the guidance of the Chicago Audubon Society with funding from Chicago Wilderness. Full implementation of regional monitoring is slated to begin in 2008. With guidance from the survey and input from consortium members, Chicago Wilderness will be positioned to provide natural resource managers, politicians, and the public with accurate and reliable information about the health of the Chicago metropolitan region's natural communities.

*Geoffrey A. Levin, Division of Biodiversity and Ecological Entomology*

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## CTAP

*continued from page 3*

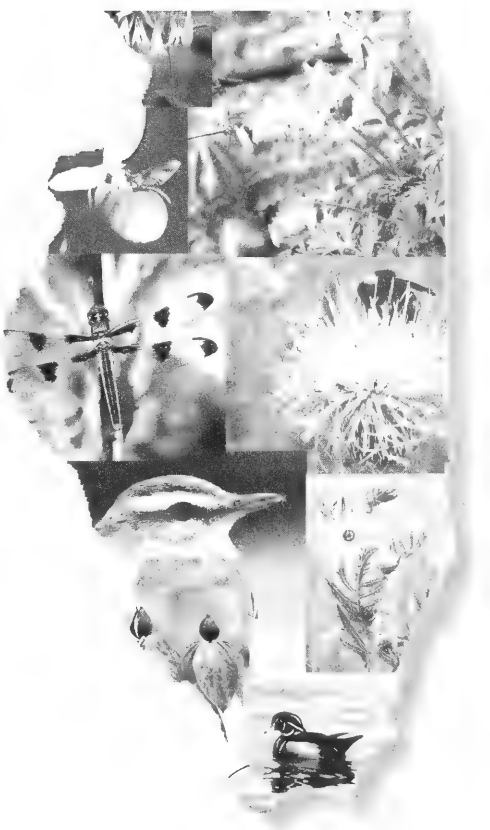
g) How can preserves and other open spaces be designed and managed to promote biological health and biodiversity?

h) How do grassland birds benefit from the Conservation Reserve Program and other grassland conservation programs?

In addition to addressing these and other questions, CTAP has initiated the *CTAP Science and Ecological Policy* series. This is an initiative designed to inform managers, researchers, and property owners using the most up-to-date ecological data we have collected, along with the most current scientific expertise on subjects such as forestry, conservation biology, and wildlife biology as they relate to specific questions and concerns held by Illinois landowners, land managers, and policy-makers. The first issue of *CTAP Science and Ecological Policy* will be an overview of management, conservation, and land managing practices in Illinois forests.

The first decade of the Critical Trends Assessment Program has produced volumes of data with which to determine the distribution and abundance of plants, birds, and stream invertebrates throughout Illinois. The next 10 years will provide a comparison by which to determine the direction of the Illinois environment. With the creation of the *CTAP Science and Ecological Polic* series, we hope to use these data to best manage and conserve Illinois' habitats.

*Michael Ward, Division of Ecology and Conservation Sciences*



*Species Spotlight*

# Southern Flying Squirrel

Susan Post

My first encounter with a flying squirrel was as a young child, entertained by the cartoon antics of Rocky the flying squirrel and his pal Bullwinkle the moose. Surely an animal like Rocky couldn't exist—a squirrel that flies? I would later learn that, yes, there were such things as flying squirrels; I even handled a museum specimen—flattened but soft. As someone who keeps a list of all squirrel species, the flying squirrel has become a nemesis. I was close once when a small group of them were frightened out of a tree occupied by red cockaded woodpeckers, but I was off looking at something else. I reveled in a friend's tale of how they come to her bird feeders every night at dusk, but there is still no check mark by the flying squirrel for me. This spring during a field trip to the Lost Mound area (the decommissioned Savanna Army Depot) a friend found a walnut with interesting holes. She picked it up from the flotsam of the Mississippi River; the walnut had two sets of evenly spaced elliptical holes. The edges had fine tooth marks. Looking around we found a small stash of holey walnuts buried in an old log. We took several back to the Illinois Natural History Survey and showed them to our mammalogist who exclaimed, "Southern flying squirrel!" I am getting ever closer to seeing this illusive animal!

*Southern flying squirrel,* Glaucomys volans.
Drawing by Aleta Holt for the INHS "Field Manual of Illinois Mammals"

Illinois has one species of flying squirrel, *Glaucomys volans*, the southern flying squirrel. Its scientific name literally translated means "flying gray mouse." They inhabit the eastern half of the United States from southeastern Canada to southern peninsular Florida. While they may be found in a variety of habitats, from the dry brush country of eastern Texas to the pinelands of the South, they prefer mature deciduous forests with an abundance of nut producing trees such as oak, hickory, or beech.

Flying squirrels have light, flattened bodies that are 8 to 10 inches long and weigh from 2 to 4 ounces. Their fur, called pelage, ranges in color from steel-gray to gray-brown and is silky and dense. The breast is creamy white. They have enormous dark eyes with brown eye rings that contrast against their gray faces. They have flattened featherlike tails that comprise 40% of their total length. A loose fold of skin extends between the fore- and hindlegs, along both sides of the body. This flap, called a patagium, is unique among North American mammals. By extending their legs and stretching the patagium like an airfoil, the squirrels are capable of graceful glides. Most of their glides are less than 100 feet in distance and the squirrels end up lower than their take-off spots.

Flying squirrels live in nests that are from15 to 20 feet above ground in cavities such as woodpecker holes. The globular-shaped nest is lined completely with plant fibers such as shredded bark, leaves, and grasses. There is usually more than one nest—primary and secondary—which may be used as feeding stations or retreats. The nests have small entries (1.6 to 2 inches in diameter) to prevent other tree squirrels from using them. Flying squirrels do not defecate in their nests. While the squirrels do not hibernate, they do undergo periods of torpor. Usually in the winter they will huddle with up to 10 to 20 other flying squirrels in order to save energy.

In Illinois mating occurs in late February or early March and again in July with young born from late March to May and in August and September. The number of young varies from two to seven. The newborns are pink and hairless with closed eyes and ears, yet by eight weeks they are adult size and furred. They are able to breed within the next year.

Populations of flying squirrels are affected by the reduction of woodland areas and by the removal of dead trees with woodpecker nest cavities. The main predators of these squirrels are Barred and Great Horned Owls, while weasels, raccoons, and black rat snakes may prey on them while in their tree nests.

Flying squirrels easily escape our notice as they are the only nocturnal squirrels in North America. Even though they may be abundant, seeing one is a rare treat. They might easily be mistaken for a falling leaf. A comment by two biologists in 1911 gives credence to their common names of "fairy diddle" and "goblins of the night."

"There is something ghostlike in this gliding flight . . .There is not only an entire absence of fluttering wings but perfect silence."

*INHS mammalogist Joe Merritt is gratefully acknowledged for providing insights and information about southern flying squirrels for this article.*

## The Naturalist's Apprentice Teacher's Page

Answers to "Looking for Signs" exercise on following page:

1-d, 2-b, 3-h, 4-c, 5-f, 6-e, 7-a, 8-g.

*The Naturalist's Apprentice*

**Looking for Signs**

Carolyn Nixon

Looking for Signs

It is common for animals to be present in an area without being noticed. Flying squirrels, for instance, are nocturnal and are seldom witnessed by people who only frequent these areas during the daytime. Many animals are very secretive and stay quiet and hidden when people are present. Many of these animals do, however, leave signs that they were there. You may find tracks, scat, debris from feeding, burrows, cast skins, and other signs. See if you can match up the signs with the correct animal.

When you are out in a natural area, look for these signs and study them. Photograph or sketch them, and then look in field guides to see if you can determine who left the clue to their activity.

1. southern flying squirrel _____
   (walnuts with smooth holes)
2. beaver _____
   (chewed tree trunks)
3. Pileated Woodpecker _____
   (rectangular holes in tree trunk)
4. crayfish _____
   (mud chimney)
5. Yellow-bellied Sapsucker _____
   (small holes drilled in straight lines)
6. leafcutter bees _____
   (round holes cut from leaf)
7. cicada _____
   (empty skins of immature insects)
8. insect galls _____
   (bulbous growth on twig or leaf)

A

B

C

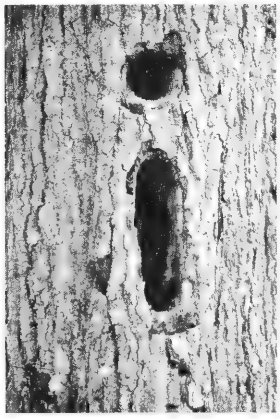
D

E

F

G

H



*All photos by Michael Jeffords (INHS) except the shot of Yellow-bellied Sapsucker holes, which was taken by Kelly Cook of INHS*

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# Beneficial Insects

*continued from front page*

and natural environments, including old-growth trees in pristine forest areas. Three of the beetle species being used in the adelgid biological control programs have been found to harbor microsporidia, fungal-like pathogens that insidiously infect the insects and cause shorter adult lifespans, larval death, and lowered egg production. The microsporidia can build up in the laboratory colonies and cause death of a large percentage of colony insects that have been painstakingly reared for biological control projects. We are currently identifying these microsporidia and learning about how they infect and are spread.

The most recent project, a collaboration between the authors at INHS and the University of Illinois and Jamie Strange and Terry Griswold at the USDA Bee Biology and Systematics Lab in Logan, Utah, addresses the potential causes of population declines of some of our most important native plant pollinators, the bumble bees. There are more than 50 species of bumble bees (Genus *Bombus*) in North America and several appear to be declining severely. Our team will approach the problem of identifying the reasons for decline by addressing two of the myriad potential causes—the isolation and fragmentation of bumble bee populations and the occurrence of diseases that might be invading North America, or are native but with effects that may be exacerbated by other pressures. Supported by a grant from the USDA National Research Initiative, we will compare historical information from museums and the scientific literature with the current ranges of six species of bees and their parasites and pathogens.

We have, in preliminary studies, identified several pathogens and parasites isolated from bumble bees collected in the American West and Midwest. Individual bees from two populations in Illinois, as well as bees from western populations, were infected with a pathogen, a microsporidium, that is a genetic match for a species that occurs in European bumble bees. We will be working to determine whether this pathogen is a recent invader that has spread across the continent or is found globally in bumble bees. Illinois residents can help by informing us about areas, particularly fields and natural areas, where bumble bees are frequent visitors so that we can sample the populations.

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ILLINOIS NATURAL HISTORY SURVEY Reports

Autumn 2007
No. 393

INSIDE



# Asian Mosquito Invades Illinois....Again

*The Asian tiger mosquito*, Aedes albopictus. Photo by Michael Jeffords, INHS Office of the Chief

At first, the introduction into Illinois of a dark white-striped, day-biting mosquito associated with waste tires sounds like déjà vu, harkening back almost 20 years to the discovery of the Asian tiger mosquito (*Aedes albopictus*) in piles of used and waste tires scattered throughout the state. Unfortunately, history is repeating itself with a new invader, the Asian rock pool mosquito *Aedes (Ochlerotatus) japonicus*, presumably introduced and spread via used tires. Ironically, the rapid detection in Illinois of this exotic import in 2006 was at least partially due to the Waste Tire Act of 1992, which helped create the Medical Entomology Program at the Illinois Natural History Survey (INHS). The Waste Tire Act was passed in order to provide for the collection, disposal, and recycling of used tires, and to fund research on vector insects associated with them.

photo by Mike Sardalis, USAMRIID

*The Asian rock pool mosquito*, Aedes (Ochlerotatus) japonicus, *a new invader to Illinois*. Photo courtesy of Mike Sardalis, U.S. Army Medical Research Institute of Infectious Diseases

The Asian rock pool mosquito was first discovered in the United States between 1998 and 1999 in three northeastern states (New York, Connecticut, and New Jersey). For a brief time, some researchers believed that the temporal and spatial overlap of West Nile Virus (WNV) transmission with the Asian rock pool mosquito distribution was more than a coincidence. They suggested this species might be the critical bridge vector of WNV to humans. *Aedes japonicus* is native to Japan, Korea, and much of eastern Asia, where it is believed to be a vector of Japanese Encephalitis Virus, which is closely related to WNV. The dispersal of the rock pool mosquito into Europe and North America appears to be the unintended consequence of the worldwide used tire market. In the United States, the spread of this exotic species is well documented due to the continent-wide heightened surveillance for WNV in mosquitoes. Fortunately, the distinctive morphological characteristics of both larvae and adults allow *Aedes japonicus* to be easily distinguished from native mosquito species in field-collected material.

On July 7, 2006, adults of the Asian rock pool mosquito were discovered in traps in a woodlot south of campus at the University of Illinois in Urbana-Champaign by INHS Medical Entomology staff. Within days, additional specimens were collected from a container and adult traps in another woodlot less than a quarter of a mile away from the first site. Due to intensive mosquito surveillance for WNV throughout Urbana and Champaign, we are reasonably certain this area

*Continued on back page*

# Illinois and Indiana Parks as Refuges for Stoneflies (Plecoptera)

Illinois Natural History Survey (INHS) collections provide the biological memory for documenting spatial and temporal changes of species across our rapidly changing landscape. The written word can serve this purpose too, but often it is outdated, based on misidentifications, and not on vouchered specimens whose identifications could be verified.

Stoneflies are a small order of some 2,000 species, about 660 of which are currently known for North America (http://plsa.inhs.uiuc.edu/plecoptera/). Larvae inhabit flowing waters the world over and are excellent indicators of water quality. Adults emerge from the water in nearly every month of the year in Illinois, assuming a brief terrestrial existence. Unfortunately, at least two extinctions have occurred (Illinois endemics) and the ranges of many other species are shrinking. The book *Precious Heritage*, a Nature Conservancy and NatureServe collaboration, reports stoneflies as the third most imperiled taxon (either by percentage or absolute number) in the USA. DeWalt et al. (2005, *Ann. Entomol. Soc. Am.* 98: 941–950) reported that in the twentieth century 28.6% of 77 species reported from Illinois can no longer be found in the state. The family Perlidae, historically composed of 28 large, predatory species, was decimated. Eleven have been extirpated and six have dramatic range reductions. The remainder are secure. Reasons for loss of so many species is not known, but some correlates exist. Species with direct egg hatch (one month), summer emergence, and prolonged nymphal growth (11 or 23 months) were lost disproportionately. Species with egg or nymphal diapause and shortened growing periods fared better. Additionally, losses were greatest in the 1950s, a time signature reminiscent of eggshell thinning in raptors related to DDT use. Perhaps these two are linked.

Figure 1. Emerging *Soyedina vallicularia* (Nemouridae) from a ravine stream habitat. Photo by R. Edward DeWalt, Division of Biodiversity and Ecological Entomology

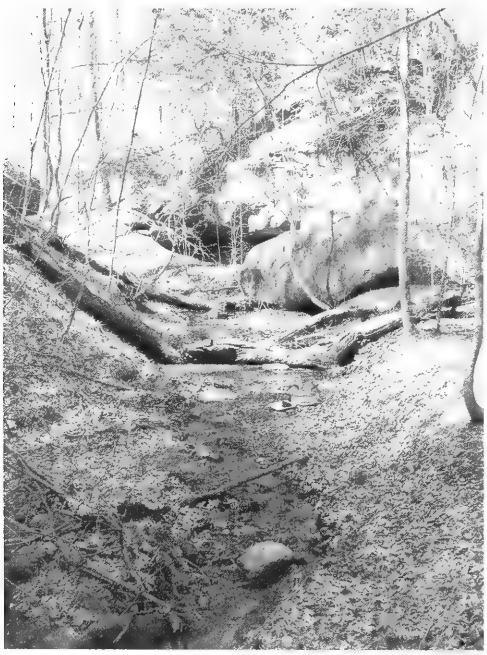


Figure 2. Ravine stream at Turkey Run State Park, Indiana. Note hemlocks in background. Photo by R. Edward DeWalt, Division of Biodiversity and Ecological Entomology

INHS collections contain many historical stonefly specimens from parks in eastern Illinois (Fox Ridge State Park, Kickapoo State Park complex, Rocky Branch Natural Area, and Forest Glen County Forest Preserve complex) and western Indiana (Turkey Run State Park, Shades State Park complex, and McCormick's Creek State Park). These, plus recent collecting efforts in Indiana presented the authors with an opportunity to evaluate the efficacy of parks for protecting stoneflies, and by extention, other aquatic insects.

The authors re-evaluated specimens from the INHS, Purdue University (Purdue), and Canadian National Collections (CNC) to determine the species historically known from Illinois and Indiana parks. Over the past two years, the authors have visited Illinois and Indiana parks in winter, spring, and summer to determine which species remained. Small and large streams were investigated, nymphs reared to adulthood, and adults collected by UV lights.

Most parks were relatively small, consisting of a few hundred to a thousand acres, and protecting a narrow band of deeply dissected seeps and small streams. They also provided a relatively short and narrow buffer for larger streams such as the Embarras and Middle Fork of the Vermilion River (Illinois) and Sugar and McCormick Creeks (Indiana). These parks fell along an east-to-west moisture gradient that promoted the formation of somewhat different but related communities from east to west.

Parks protected species requiring ravine stream habitat (Fig. 1) much better than those requiring larger streams. Ravine streams have a limited watershed and depend upon groundwater as a source of cool, clean water. Only 2 of 16 ravine species were lost: the winter stoneflies *Allocapnia illinoensis* from Rocky Branch and *Paraleuctra sara* from Turkey Run (Fig. 2). Larger streams integrate the effects of a broad landscape. The Embarras River, Middle Fork, Sugar Creek, and McCormick's Creek lost 13 of 27

*Continued on page 5*

# Audio Radio Telemetry and Studies of Communication and Movement

The Illinois Natural History Survey (INHS) has been a central player in ecological radio telemetry—the transmission of data from radio-tagged animals, since the inception of the field (Cochran and Lord 1961). Animal tracking through radio telemetry is now a standard tool in studies of animal movement and behavior, and currently transmitters that broadcast information beyond position are being developed. Here we describe studies which employ audio transmitters, developed by Bill Cochran, to study bird song and to assess and monitor bird communities.

A radio-tagged thrush using radio telemetry technology developed by William Cochran of INHS. This transmitter was an early prototype used in the 1960s. Photo from INHS Image Archives

### *Bird Song*

The audio transmitters we use (~ 1.3 g) are equipped with tiny microphones (0.1 g) that broadcast both audio (AM band) and position (CW band) continuously from the backs of individual birds for up to three weeks. Using simultaneously broadcast audio and spatial data we are able to study both the vocal performance of birds and the spatial and social context of their songs. Audio transmitters provide a valuable alternative to recordings made with hand-held microphones. They allow us to build comprehensive records of species and individuals, and capture sounds that are easily missed using hand-held recording devices, e.g., vocalizations of very low amplitude or very rare vocalizations. Audio transmitters are also useful for studies of vocalizations that occur at specific locations, such as nest sites.

The Northern Cardinal is of particular interest to us because both males and females sing extensively, unusual in temperate zone birds, and because use and development of song appear to differ between the sexes. We've analyzed a small portion of the radio-transmitted audio data we've collected over the past two years and have established that song in both sexes is far more complex than previously thought. Both sexes engage in song matching bouts, probably a means of mutual assessment, well before the onset of breeding. We are currently engaged in studies to test hypotheses we've generated with these data regarding song function, structure, and development in this species.

Audio transmitters produce an enormous amount of data, both in terms of real time recording (we deal with recordings that are days or weeks long rather than the traditional minute or hour-long recordings) and in terms of file size (eight hours of recording generates over two gigabytes of data). Concurrent with our field studies, we are developing the tools to store and analyze these huge data sets in partnership with The National Center for Supercomputing Applications (NCSA) and the UIUC School of Library and Information Science.

### *Environmental Acoustics*

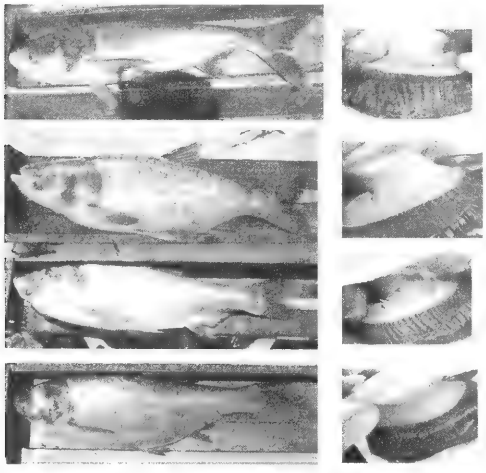
In recent years interest in the use of stationary microphones placed in the environment to monitor bird communities has grown rapidly. Most researchers have sought to use environmental microphones as replacements for unreliable human audio surveys. Arrays of microphones are also being tested by researchers interested in long-term habitat monitoring. However, the utility of microphone arrays has been limited by the need to move large audio files from individual microphones to a central location for processing and analysis. Some researchers rely on cables to move their data, but using cables greatly restricts the size of the area that can be monitored. Others have attempted to push audio files over wireless Internet, but this method is currently inefficient

*Continued on page 5*

# Hybridization between Bighead and Silver Carp in the Mississippi and Illinois Rivers

Bighead and silver carp were brought to the U.S. in the 1970s for use in aquaculture. Subsequently, both species escaped into the Upper Mississippi River system and now have reproducing populations established in portions of the Mississippi, Missouri, Ohio, and Illinois rivers. Since the introduction of Asian carp into the Mississippi (MR) and Illinois (IR) rivers, they have become widespread throughout these waterways. The abundance and rapid growth of these species may impact native planktivores including gizzard shad, paddlefish, and bigmouth buffalo (a highly marketable fish in Illinois commercial fisheries). In addition, leaping silver carp present a danger to recreational boaters. Until now, most research efforts have focused on understanding ecological impacts based on two distinct taxonomic species.

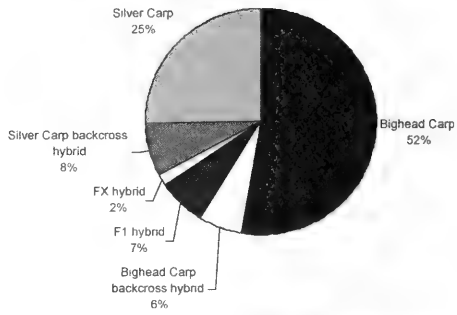
Morphological observations of Asian carp collected during our routine fish surveys in MR Pool 26 suggested potential hybridization. Occasionally, captured specimens exhibited characteristics that deviated from taxonomic keys. Most notably, keel development was inconsistent for both Asian carps (fish exhibited the morphology of bighead carp, but possessed the keel development of silver carp, and vice versa). Subsequent observations of gill rakers revealed that in some fish, these structures were neither comby (bighead carp) or spongy (silver carp) in appearance, but instead, were twisted. Each occurrence of these variants was recorded throughout the field season. Analysis later revealed that more than15% of all collected Asian carp exhibited keel or gill raker abnormalities.



Pure bighead carp (top), hybrids (middle), and silver carp (bottom) and their corresponding gill raker structure. Photos by INHS Great Rivers Field Station staff

In 2005, we set out to determine if hybridization was definitively occurring between bighead and silver carp. Our study objectives included assessing the extent and prevalence of hybridization between bighead and silver carp throughout various reaches of the MR and IR by examining several allozyme loci, and determining whether a gender bias exists for hybrid contribution in these two species by assaying a conserved region of the mitochondrial genome. Asian carp were sampled from MR Pools 19, 20, 26, and open river; also, from the IR Alton and La Grange reaches. Each species and their potential hybrids were collected via trammel nets along with incidental captures from jumping individuals at several locations within this range. Sex, length, weight, and notable morphological differences were recorded to assess the impact hybridization may have on these variables. Tissue samples (muscle, liver, and eye) were collected from each individual and served as a source for both soluble enzymes for protein electrophoresis and mitochondrial DNA (mtDNA) for gender bias assay.

Protein electrophoresis of fish tissues collected in MR Pool 26 revealed that 22% of sampled bighead and silver carp exhibited some degree of hybridization, ranging from first generation hybrids (F1) to both bighead and silver carp backcrosses. Although analyses are ongoing, we are confident that hybrid Asian carp are also present in more northerly MR pools and IR reaches. This high percentage of hybridization (and wide extent) is unlikely to occur as an isolated, chance event. If hybridization continues at this rate, a potential for a hybrid swarm exists. This may lead to the emergence of a new species complex with pure bighead and silver carp becoming increasingly uncommon. It is important to understand the rate of hybridization, its prevalence, and what role this new species complex plays in our big-river ecosystem. True F1 hybrids tend to have twisted gill rakers and intermediate keel and eye positions. Because hybrid backcrosses have been identified, it is evident that hybrids can successfully reproduce. In addition to pervasive hybridization, mtDNA analysis of the same set of fish indicated that silver carp females were most likely to contribute to the hybrid condition. A possible explanation for this finding may include the potential for an expanded breeding season (often introduced species lose environmental cues which isolate them temporally and spatially from one another). Ultimately, hybridization could result in heterosis (hybrid vigor) in which the new species complex becomes superior to either of the pure species because it broadens its niche and becomes more adaptable. Conversely, morphological or physiological differences could hinder fecundity or fitness. Reduced jumping behavior of bighead and silver carp reciprocal hybrids as compared to pure silver carp was observed in aquaculture settings in the past. It follows that if such behavior is exhibited by wild hybrids, confrontation of these fish with recreational boaters may be reduced. Also, a substantial commercial market has developed in Illinois for Asian carp. The local economy (and means of population control through harvest) may suffer if this market is hindered by the presence of oddities (hybrid fishes with nontypical morphology) that are less desirable to processors and patrons. Addressing many of the issues above will help us better understand the social, economic, and ecological impacts that Asian carp hybrids may have on our big rivers.




Percentages (n=120) of pure bighead carp, silver carp, and their hybrids collected in Mississippi River Pool 26.

*Chad R. Dolan, Jim T. Lamer, John H. Chick, and John M. Epifanio; Division of Ecology and Conservation Sciences*

## Stonefly Refuges

*continued from page 2*

large, predatory stoneflies of two families. Replacing these species are perlids whose life cycles have an egg diapause that limits their risk to pollution and other disturbance to February through June.

Stoneflies in ravine streams appear to be well protected, but the predicted warmer and drier times ahead call for greater vigilance to protect these relict habitats of cooler times. The purchase of land and extension of natural vegetation on tablelands above ravine streams would buffer them against future warmer temperatures, smooth out the release of water throughout the year, and reduce crop fertilizers and pesticides that percolate through the groundwater. Many of these stream channels are used as trails, a practice that should be discontinued for the most vulnerable stretches. Damage to large streams has already been done and natural recolonization of lost species is highly unlikely. Recent unpublished data demonstrate that species of *Acroneuria* (Perlidae) would have to cross inhospitable cropland or along degraded rivers for 100–300 km to reach historic Illinois locations—most traveling from out of state. The Middle Fork of the Vermilion appears to be of sufficient water quality to support reintroduction of one or more of these large species. *Acroneuria frisoni* (Fig. 3), named for a former Chief of the INHS (Theodore Frison), would be an appropriate candidate.

*Dr. R. Edward DeWalt and Dr. Donald W. Webb, Division of Biodiversity and Ecological Entomology*

Figure 3. *Acroneuria frisoni* (Perlidae), a candidate for reviving part of Illinois' biological heritage. Photo by Michael Jeffords, INHS Office of the Chief

## Telemetry

*continued from page 3*

and time consuming. We are taking a different approach. We are building larger versions of the audio transmitters for single birds for use in environmental microphone arrays. Currently we are building and testing an array in the South Farms at UIUC. Transmitting audio data by radio will allow us to record synchronous, high-fidelity audio from many microphones to a single multiple channel source. As with audio transmitters on individual birds, these arrays generate very large, and even more complex, audio files that require special processing.

The audio transmitter arrays are arranged in the habitat so that every part of the environment is recorded simultaneously by at least three microphones (positioning depends on what types of sounds you are focusing on). This allows us to locate each sound source in the environment (trilaterate) in real time— a very exciting development which also requires highly sophisticated software.

***Software Development***

For the past two years we have been working with the NCSA and the UIUC School of Library and Information Science to develop the tools needed to fully realize the potential of audio transmitters. We are already using software tools developed by our collaborators to analyze some aspects of the audio data collected from individual birds, and new tools are being developed as we identify specific needs. Tools capable of distinguishing between individuals belonging to different species are needed to analyze data from the microphone array, and these are also being developed by our NCSA partners. Even more sophisticated tools are required to make audio-spatial location a reality, and with this in mind we have recently enlisted the help of internationally recognized audio-spatial experts in the Electrical and Computer Engineering Department at UIUC.

The INHS remains in the forefront of ecological radio telemetry. The advances in radio telemetry described here, and in the hardware and software tools to support them, will have multiple applications in the fields of animal ecology, animal behavior, species conservation, and habitat monitoring.

*David A. Enstrom and Michael P. Ward, Division of Ecology and Conservation Sciences*

*Species Spotlight*

# Wolf Spiders

Susan Post

Have you ever been hiking when a large brown spider races across your path, or noticed that at night your flashlight picked up mysterious glowing dots? Perhaps these were chance encounters with Illinois' version of a wolf—a wolf spider.

Photo by Michael Jeffords, INHS Office of the Chief

Wolf spiders belong to the family Lycosidae and they are among the most common spiders with anywhere from 2,000–3,000 species worldwide. They are found from the arctic to the tropics. There are 238 species north of Mexico, and Illinois has at least 47 species of wolf spiders. They have common names such as dotted wolf, rapid wolf, stone, shore, brush-legged, and two-lined. Their common name comes from their genus name *Lycos*. In Greek this is the root word for wolf. This may refer to the way the spiders catch their prey—instead of using a web they stalk and chase like a wolf.

Wolf spiders have eight legs and two body parts—the celphalothorax (the combined head and thorax) and an oval abdomen. Their fanglike mouthparts are called chelicerae. Their legs are long and tapered and adapted for running. To gain traction they have adhesive hairs on the soles of their feet.

Wolf spiders range from a half inch to two inches long and are quite hairy. They are drably marked with off-white, black, yellow, or red on a brownish or blackish background. Their carapace (the top portion of the celphalothorax) often has two or more distinctive dark longitudinal stripes. Wolf spiders are often the same color as their background so they can be hard to see. They are ground-dwelling spiders so look for them under rocks and logs, near streams, in leaf litter, and at the bases of plants. Some will construct burrows in the soil or utilize cracks and crevices in rocks for retreats; others will seek shelter under bark.

These spiders have good vision and a highly developed sense of touch. They have eight eyes, all dark and arranged in three rows. The four anterior eyes are small, dark, and in a nearly straight line. The posterior row is recurved to form two rows of two eyes each and these are much larger than the anterior eyes. These eyes also have a layer of light reflecting crystals, the tapetum, behind the light sensitive retina, giving the eyes a silvery appearance and causing them to shine brightly in a beam of light.

A distinctive behavior of wolf spiders is the carrying of their egg sacs by females. The female attaches the globular egg sac to her spinnerets (located at the posterior end of her abdomen) and carries it until the eggs hatch. The female will open the seam of the egg sac and wait for the young to clamber upon her abdomen and hang on to her abdominal hairs. If any fall off they climb up their mother's legs to get back on. They will ride for several days and will be nourished by the yolk within their bodies. After their first molt they descend and are on their own. They will undergo several molts before reaching adulthood. Wolf spiders live for several years.

Wolf spiders are active hunters that patrol the ground for insects and small spiders. Usually patrolling at night, they spot their victim, give chase, capture, and inject it with paralyzing venom. Soon the victim's dissolved tissues are sucked out. Wolf spiders are also the hunted. They are food for small lizards, insectivorous mice, shrews, and turkeys.

**Shining for Spiders**

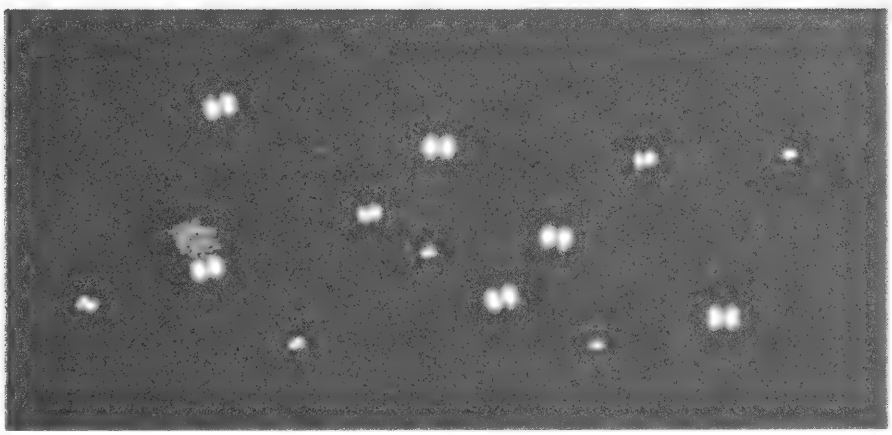
Carolyn Nixon

While wolf spiders are very common, they are most active at night, so people seldom notice them. They can, however, be easily spotted at night with a headlamp or flashlight held at eye level. Direct the light to the ground about 10 feet in front of you. When light strikes a spider's eyes, it is reflected back and the eyes glow like gleaming, turquoise jewels. Once you spot it, you can approach closely with your light to get a good look at the spider. Please do not capture or injure the wolf spider. It is a valuable member of the natural community in your yard.

You can survey the wolf spiders in your yard and keep a record of their life histories. At regular intervals, such as once a week, go out into your yard at night with a headlamp or flashlight. Write down the date, time, and general weather conditions in you notebook. Walk the same route each time, at about the same speed. This will work best if you use an area where the grass is kept mowed, or along a path. Write down how many spiders you see and how large they are (large, medium, small, or tiny). Look for mother spiders with their broods of spiderlings on their backs. You will see the two large glowing eyes of the mother, and just behind them many tiny, turquoise, glitterlike sparkles. These are the eyes of the babies! Later, when the babies are on their own, you may see many tiny pairs of eyes spread out across the lawn. There may even be too many to count.

Drawing by Carolyn Nixon, INHS Office of the Chief

Wolf spiders are not the only tiny creatures whose eyes reflect light. The eyes of fisher spiders (Pisauridae) also glow, and the eyes of many moths and some beetles glow orange. If the grass is wet from rain or dew, the droplets of water will glisten white.



Drawing by Carolyn Nixon, INHS Office of the Chief

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## Asian Mosquito

*continued from front page*

was at or near the initial invasion site and the distribution of *Aedes japonicus* was very localized. Our detection of this species in Urbana represented the first state record for Illinois; however, by the end of the summer, there were reports of multiple introductions throughout the state. A graduate student at Illinois State University found *Aedes japonicus* in a southern tire site near Effingham; the Medical Entomology staff collected it in northern trap sites around LaSalle-Peru; and the South Cook County Mosquito Abatement District found it in traps near their office in Harvey. In Urbana, the rediscovery of larvae and adults in 2007 at the same woodlot on the South Farms indicates the species successively overwintered and is on the road to establishing a permanent foothold in our area. With the addition of Illinois, this species is now reported from 27 states, the District of Columbia, and 2 Canadian provinces.

In August 2007, adult specimens were also captured about a mile north of the original focus, heading toward campus. The Asian rock pool mosquito has a history of being initially detected in limited sites and in low numbers, only to become a relatively common mosquito within two to three years. The preferred habitat tends to be natural or artificial containers in shaded areas with water rich in organic matter, similar to habitats preferred by our native *Culex* vectors of WNV. This may result in a competition for resources between these species. The invader also has a broad host range, including birds and mammals, and tends to bite during the day when you enter its habitat.

The complexity of WNV transmission makes it difficult to predict the ecological and epidemiological implications of *Aedes japonicus*. It could cause an increased risk of WNV transmission to mammals, but alternatively, the feeding on mammals could detract from the natural bird-to-mosquito-to-bird cycle, thereby reducing the intensity of transmission. The Medical Entomology Program will continue to monitor this species to determine its impact on disease transmission and the abundance and distribution of *Culex* species.

*Richard Lampman and Joel Morris, Division of Biodiversity and Ecological Entomology*

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ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Winter 2008
No. 394

INSIDE



# Evaluating Waterbird Use of Wetlands Restored through the Conservation Reserve Enhancement Program

Although many of the original wetland areas in the lower 48 states of the U.S. have been lost, progress has been made in recent decades to reduce additional loss and restore wetlands throughout the Midwest. Conservation programs on private land have been one of the best strategies for the recovery of valuable wetland acreage. The U.S. Department of Agriculture introduced the Conservation Reserve Enhancement Program (CREP) in 1998, forming partnerships with state and nongovernmental organizations to address specific regional priorities.

*Lotus bed at Kelly Lake in Schuyler County. This restored wetland complex was the largest multi-stakeholder CREP project in the state.*

Photo by Ben O'Neal, INHS Division of Ecology and Conservation Sciences

Since the inception of CREP, over 37,000 ha of land have been enrolled in wetland practices nationwide. The Illinois River watershed has benefited greatly, with 14,000 ha enrolled in wetland practices ranging from discrete seeps to large marshes. Wetlands enrolled in CREP provide many ecological functions, but may be particularly important as habitat for migrant and resident waterbirds; however, their use as stopover and breeding sites and factors associated with their use have not been evaluated.

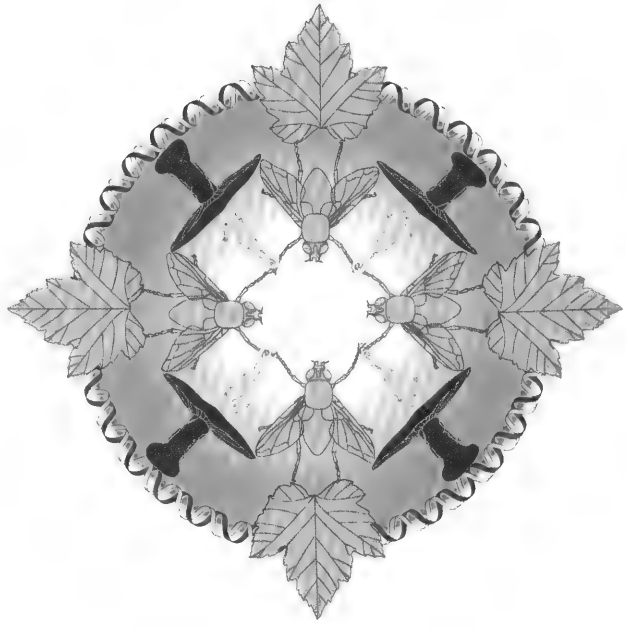
*Co-author Ben O'Neal conducting a waterfowl survey at a successful wetland restoration site along the La Moine River in Schuyler County.* Photo courtesy of Helen O'Neal

We surveyed a random sample of CREP wetlands in the Illinois River watershed in 2004 and 2005 to quantify use of restored wetlands by spring migrating and breeding waterbirds. Sites were dispersed throughout the watersheds of the Illinois, LaMoine, Spoon, and Sangamon rivers, and fell within the Western Forest-Prairie, Illinois River Bottomlands, and Grand Prairie natural divisions. Seventy-five percent of wetlands supported use by waterbirds during spring migration. Total number of use-days (a measure of how much each wetland is used by birds: 1 bird on a wetland for 1 day is 1 use-day) for the entire spring migration ranged from 0 to 49,633 per wetland and averaged 6,437 ± 1887 (SE). Semi-permanent wetlands supported the greatest total number of use-days and the greatest number of use-days relative to wetland area. Species richness ranged from 0 to 42 ($\bar{x}$ = 10.0 ± 1.5 [SE]), and 7 of these species were classified as endangered in Illinois. Dabbling ducks were the most abundant guild of waterbird (69% of individuals recorded), followed by diving ducks (9%), shorebirds (5%), Rails and Coots (5%), and geese (5%). The density of

*Continued on back page*

# Sharing Biodiversity Data: Opportunities for Collaboration

Expectations of sharing data are different today than they were in 1995 when we were in the first "class" of awardees of the then ground-breaking National Science Foundation program called Partnerships for Enhancing Expertise in Taxonomy or PEET (not to be confused with the gourmet coffee consumed in prodigeous amounts by our lab group!). One of the three pillars of the PEET program was to make our data available electronically, meaning transcribing collecting information from tiny labels on the nearly 135,000 specimens from collections around the world in the fly family Therevidae, otherwise known as stiletto flies. This medium-sized family (1,175 validly recognized species in 124 genera, with more awaiting recognition) of one of the megaorders of insects, the Diptera (=flies), was poorly known until NSF funding enabled the training of the next generation of dipterists using this family as a model. The collection of specimens for morphological and molecular study, the publication of illustrated papers and monographs, the creation of a database (Mandala) to aggregate information known about this family, and a Web site to proclaim to the world the work being done were also provided by PEET.



Making data available to a broad audience is desirable and even required by funding sources supporting our research and collections. The Global Biodiversity Information Facility (GBIF ) plays no small part in leading this charge not only in assembling an electronic catalog of names, but with the debut of its new portal (http://data.gbif.org/), with information from over 220 data providers and nearly 1,500 datasets that may be mined. While laudable, the steps to make these datasets available to GBIF are often beyond the scope of those without robust information technology support, making these datasets vulnerable to being lost as grants end, data and database stewards change priorities, retire, or leave the field. However, one way to capture and integrate these datasets is through Discover Life (http://www.discoverlife.org/), whose mission is "to assemble and share knowledge in order to improve education, health, agriculture, economic development, and conservation throughout the world." With nearly 1.2 million species represented, its major strengths include mapping and on-line illustrated identification tools. Mapping of taxa, specimens, and collections is in collaboration with TopoZone.com. As with GBIF, Discover Life (DL) does not take ownership of data provided to it, but attributes it back to its source either by drilling back to a provider's database or denoting its ownership throughout the display process.

Our data on the fly family Therevidae is an example of a mature database (http://www.inhs.uiuc.edu/research/mandala/TherevidWebMandala.html) that has been working its way towards being served to GBIF, but was able to be mapped and represented with DL beginning in 2003. Discover Life accesses exported text files of over 1,300 valid (accepted) taxonomic names (http://www.discoverlife.org/mp/20q?search=Therevidae) and nearly 123,000 georeferenced specimens, which it updates daily. Users choose a taxon and where specimens exist. Scalable distribution maps are automatically generated with clickable data points, allowing users to see details about individual specimens. The real power of the system is in the customizable mapping (http://www.discoverlife.org/mp/20m?act=make_map). Users can map one or more taxa from multiple data sources or entire datasets, restrict or expand mapping by data source(s) or points, center maps by clicking or using fixed latitude/longitude or UTM coordinates, and make maps for display or publications in color or black and white. Satellite, topographic, and for some areas of the globe, photo maps, allow visualization of the landscape.

As has happened with many initiatives, development of GBIF and DL has taken place largely in parallel, often targeting slightly different audiences, with somewhat different goals. One of the strengths of GBIF is its commitment to the history of taxonomic names and its adoption of TDWG standards. A weakness has been the difficulty, real or perceived, for many users to get their data to GBIF. Discover Life can quickly map specimens of one or more taxa, drawn from single or multiple data sources. It automates data cleaning and accepts tab-delimited files that do not need to be independently available on the Internet. In December 2007, a new collaborative initiative was forged between GBIF and DL that will benefit both organizations as well as data providers such as INHS and data consumers like conservation groups.

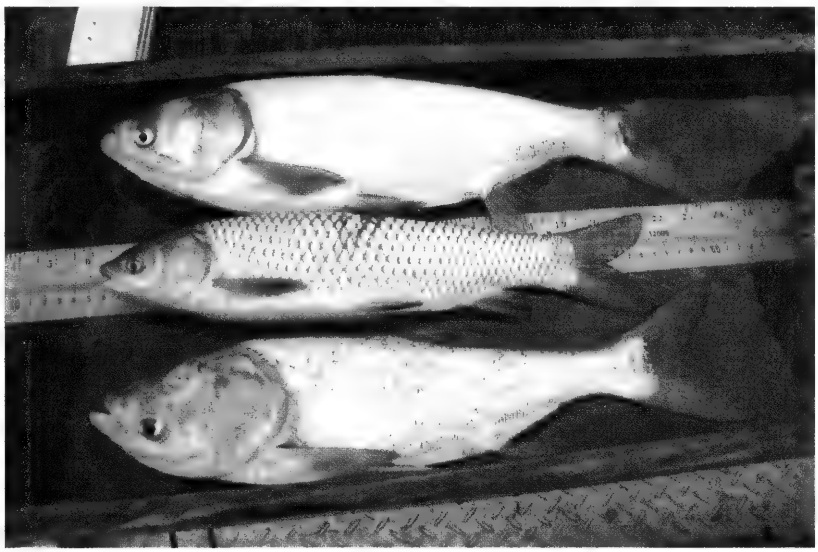
*Gail E. Kampmeier, Division of Biodiversity and Ecological Entomology*

# Bioenergetics of Invasive Asian Carps



Bighead and silver carps (*Hypophthalmichthys nobilis* and *H. molitrix*), commonly referred to as Asian carps, were introduced to the United States from China in the 1970s. They have since spread throughout the Mississippi River basin and have developed large populations in numerous aquatic ecosystems, including the Illinois River and its backwater lakes. The carps have moved to within 25 miles of Lake Michigan, which is connected to the Illinois River via the Chicago Sanitary and Shipping Canal, and are a potential threat to colonize the Great Lakes. Asian carps are fast-growing, large filter-feeders that are able to substantially reduce phytoplankton and zooplankton biomass. Recent research suggests that Asian carps negatively affect native fishes in the Illinois River, including bigmouth buffalo (*Ictiobus cyprinellus*) and paddlefish (*Polydon spathula*). If Asian carps become established in the Great Lakes, they may cause negative impacts on important native fishes by competing for plankton resources and altering the planktonic food web. However, the success of Asian carps in colonizing and establishing populations in the Great Lakes may depend on how effectively they can grow in low-nutrient conditions. Asian carps are associated with eutrophic (high nutrient) conditions in both their native and non-native habitats. Most areas of the Great Lakes are oligotrophic (low nutrient) to slightly mesotrophic (moderate nutrient), with relatively low densities of both phytoplankton and zooplankton, especially since the arrival of zebra mussels. These low plankton densities would likely necessitate large energy expenditures by the filter-feeding carps to find and capture enough plankton food to meet their metabolic needs.

Scientists at the Illinois Natural History Survey (INHS) are working on a project funded by the National Sea Grant College Program to develop bioenergetic models for bighead and silver carps. A bioenergetic model is a set of equations that describes how the metabolism of an organism (e.g., growth, consumption, respiration, excretion) is affected by temperature, body size, swimming speed, and other relevant factors. The goal in developing these models is to understand the energy budget of Asian carps so that their minimum food requirements can be predicted. After accounting for energy losses due to swimming, respiration, and excretion, the minimum food levels required to sustain Asian carps can be translated to minimum plankton densities. Using this information and previously published data from Great Lakes plankton surveys, researchers should be able to predict which regions in the Great Lakes have high enough plankton densities for Asian carps to survive and grow. Ultimately, this information will help resource managers and decision makers charged with developing management strategies for invasive species.

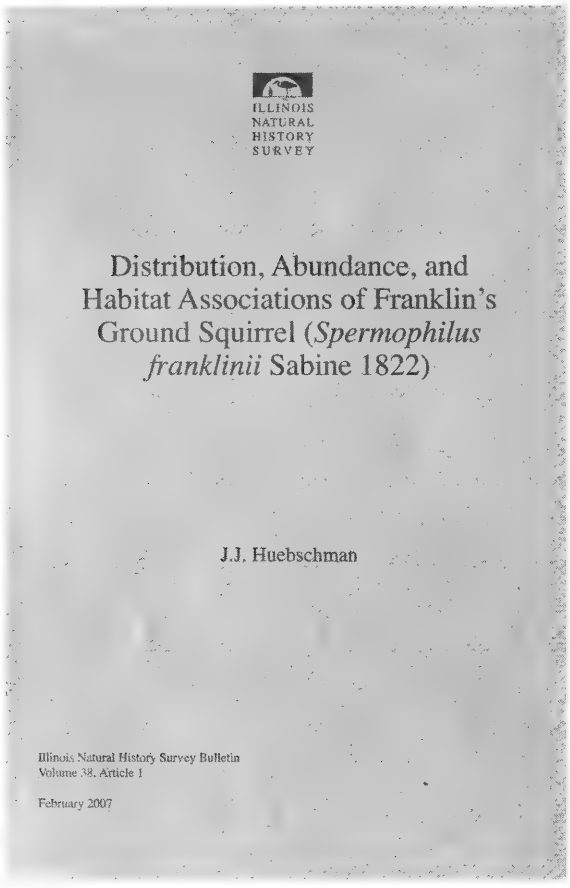


*From top: silver carp, grass carp, and bighead carp.* Photo from INHS Division of Ecology and Conservation Sciences

Experiments are currently underway to gather data for the bioenergetics models. INHS professional scientist Dr. Walter Hill oversees the Sea Grant project in collaboration with University of Nebraska's Dr. Mark Pegg. Pegg and his student conduct respirometry studies, and INHS researcher Dr. Sandra Cooke conducts mesocosm growth experiments. Preliminary mesocosm results indicate that bighead carp growth is compromised under plankton densities similar to those found in oligotrophic to mesotrophic ecosystems. In addition to the bioenergetics of Asian carps, a secondary objective of these growth experiments is to determine the ecological impacts of bighead and silver carps on plankton communities. Asian carps may selectively feed on zooplankton species that are larger or less evasive, which can alter zooplankton community composition. Furthermore, it has been suggested that Asian carps, especially silver carp, can indirectly alter plankton communities by competing with zooplankton such as *Daphnia* for phytoplankton food sources. Scientists hope to elucidate these ecological effects in order to better understand the current impact of Asian carps in the Illinois River and other non-native habitats and to predict the potential impact of Asian carps in the Great Lakes.

*Sandra L. Cooke and Walter R. Hill, Division of Ecology and Conservation Sciences*

# Recent INHS Publications and Educational Materials

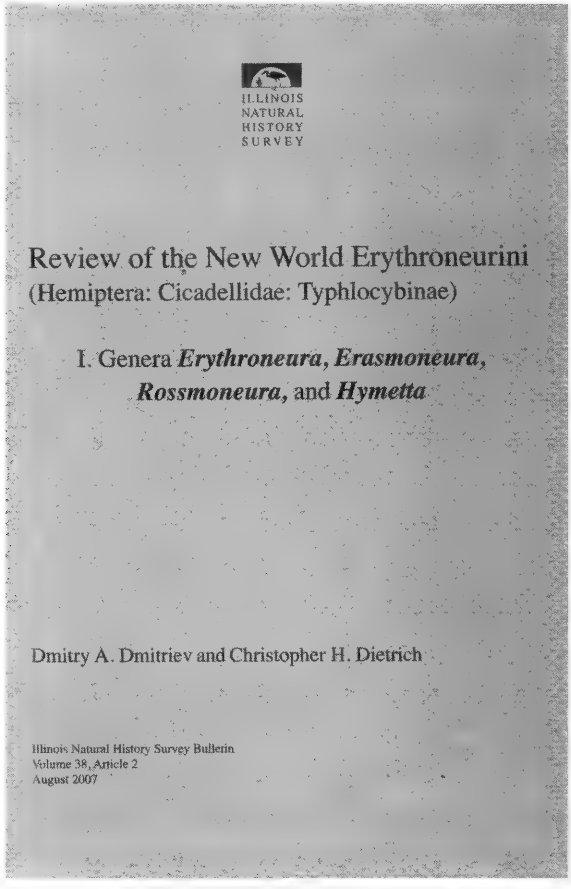



INHS Bulletin 38(1): *Distribution, Abundance, and Habitat Associations of Franklin's Ground Squirrel* (Spermophilus franklinii *Sabine 1822*)

Softcover—58 pp.

$10 per copy + shipping and handling

Order code: B38(1)




INHS Bulletin 38(2): *Review of the New World Erythroneurini—I. Genera* Erythroneura, Erasmoneura, Rossmoneura, and Hymetta

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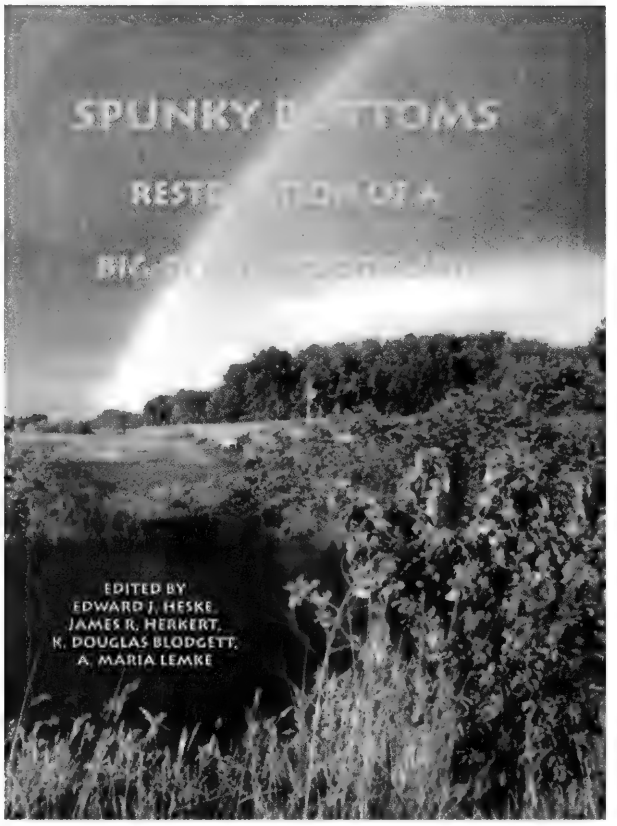
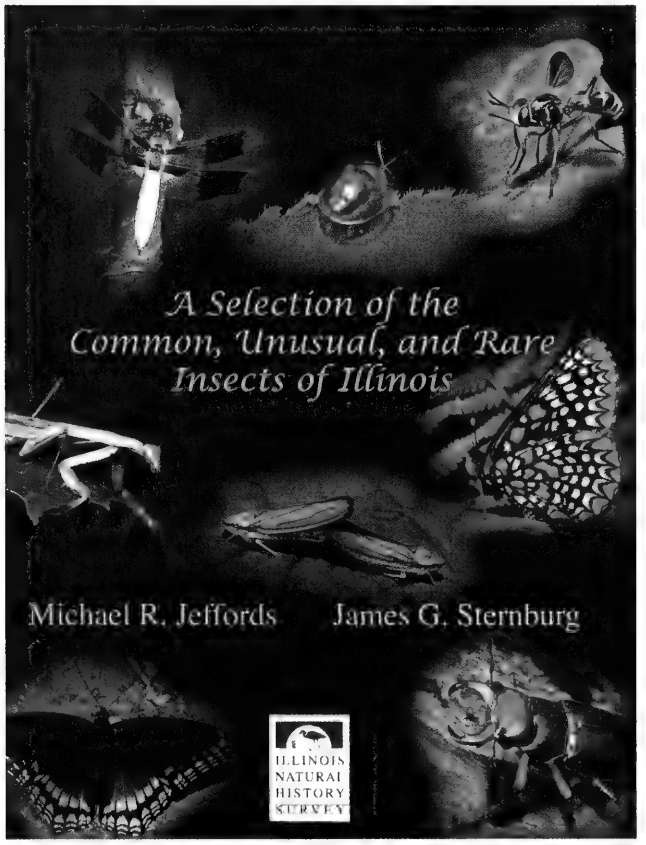



INHS Special Publication 29: *Spunky Bottoms—Restoration of a Big-river Floodplain* (Symposium Proceedings)

Softcover—44 pp.

$3 per copy + shipping and handling

Order code: SP29




INHS Educational Material 01: *A Selection of Common, Unusual, and Rare Insects of Illinois*

Softcover—21 pp.

$3 per copy + shipping and handling

Order code: Educational Material 01

For more information about INHS Publications and Educational Materials, or to place an order, please contact:

Vickie Bohlen

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http://www.inhs.uiuc.edu/chf/pub/howtoorder.html

*Species Spotlight*

# Long-eared Owl

Susan Post

The arrival of winter is not heralded by any calendar date for me, but by the arrival of Long-eared Owls at a local park. They arrive in December and usually stay until February, providing glimpses into the life of a silent predator.

Owls are efficient predators designed for darkness. They have broad wings so their weight is spread over and supported by a relatively large surface area when they are flying. Their feathers are finely fringed, the edges providing a damping down of the movement of air rushing around the surface. This enables owls to make their way in and out of the shadows in silence. Owl eyes are large and located in a forward position on their faces. This forward position allows a part of the visual field to be scanned by both eyes. They have widely spaced and highly developed ears, which are situated just behind the eyes and covered by head plumage. These aid in homing in on nearly silent and elusive prey.

*Long-eared Owl* (Asio otus).
(Photo by Michael Jeffords, INHS Office of the Chief

The Long-eared Owl, *Asio otus*, is widely distributed in North America, Eurasia, and Northern Africa. At one time Illinois supported a sizable breeding population. Now most sightings of Long-eared Owls in Illinois are during November to mid-March when they are winter residents.

The Long-eared Owl is a medium-sized woodland owl, larger than a Screech Owl but smaller than a Great Horned. Its plumage is brown to buff with heavy mottling and barring. These vertical striations match the striated bark of the coniferous trees in which it roosts. It has wide, staring yellow eyes, heavily feathered legs and feet, an orange face (facial disc), and distinctive long ear tufts. If danger should threaten, the owl presses its plumage to its body and stretches upward, ear tufts erect, assuming a long thin posture and appearing like a broken off stump.

These owls roost (spend the daylight hours) perched near tree trunks in dense foliage, making themselves rather invisible. Long-eared Owls prefer roosts that are adjacent to open grassy, marshy, or desert areas used for hunting. Where available they prefer stands of young conifers for roosting as well as breeding. In the winter roosting birds seek sheltered places that provide cover, easy access, and escape. Prime locations have a southern exposure that will block northerly or westerly winds and catch the warming rays of the sun. Small open areas surrounded by heavy cover are ideal. Winter roosts of Long-eared Owls may contain up to 50 individuals.

Long-eared Owls usually begin their activity at dusk, gliding noiselessly and low to the ground. They hunt by ranging over fallow fields, clearings, and grasslands and usually hunt from dusk to just before dawn, flying at about three to seven feet above ground with their heads canted to one side listening for prey. If prey is spotted the owl stalls and drops down with its talons spread, pinning the animal to the ground as it absorbs the shock of the bird's weight. Small prey is usually swallowed immediately. Voles are the most common prey but deer mice, squirrels, rabbits, and birds may be taken.

Once prey is captured, Long-eared Owls, like most other owls, bolt their prey whole. The stomach juices of owls are less acidic so once the soft parts have been dissolved, the indigestible fur, bones, and teeth are regurgitated as tightly packed pellets. Long-eared Owl pellets are oval or cylindrical, grayish, and about two inches long and three-quarters of an inch thick. They are regurgitated three to four hours after a meal.

While males may begin their territorial calling in the winter, nesting occurs from mid-March through May in North America. Old stick nests of crows, herons, or hawks are often used. These nests are mostly located in wooded sites, often with a screen of shrubbery or branches and are 15 to 30 feet above ground. These old nests are lined with strips of bark, feathers, leaves, and moss before the four to five eggs are laid. Incubation of the eggs is 25–26 days with hatching occurring over a period of several days. While the nestlings are capable of flight after five weeks, they are not independent of the parents until after two months.

Natural enemies of Long-eared Owls include the Great Horned and Barred owls. Raccoons are major predators of eggs and nestlings.

# Dissect an Owl Pellet

Carolyn Nixon

Dissect an Owl Pellet

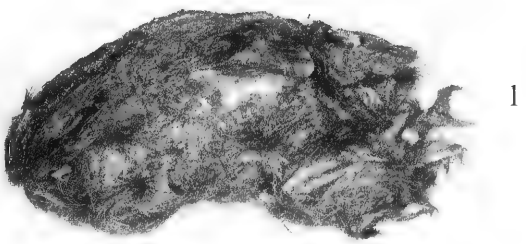
Owls do not chew their food like mammals or pull the meat from bones like hawks. Instead, they swallow their prey whole. After the meat is digested, the owl must regurgitate the undigested fur and bones. These are compacted into tight oval masses and expelled from the mouth. These regurgitated masses are called owl pellets. Since owls routinely roost in the same place during the day, owl pellets can sometimes be found in large numbers under a roost tree. Biologists collect these pellets and sort through them, removing the bones to determine what the owl has been eating. Most of the bones will be intact, but no longer connected to each other.

If you are lucky enough to find an owl pellet, you too can explore what the owl has eaten. You will need a low, flat-bottomed pan, a teasing needle from a dissection kit, and a pair of fine-tipped forceps. A magnifying glass or a dissection microscope would be helpful, but not necessary.

To dissect an owl pellet and expose the bones inside, set the owl pellet in front of you on the pan (**Photo 1**). This will help keep all of the parts together. With your teasing needle and forceps, gently loosen the pellet. Be very careful not to break any of the bones. Try to tease pieces loose from the main pellet (**Photo 2**). Once you have loosened up the pellet and pulled it apart into smaller pieces, carefully pull apart each section (**Photo 3**). You should be able to pull pieces of bone away from the fur. Some of the bones will be very tiny. Pile the bones up in one corner of the pan. When you have sifted through the fur and are sure you have found all of the bones, remove the fur from the pan. You can put it in a small plastic bag or jar to save it, or you may discard it.

Now spread the bones out on the pan and begin sorting them into pieces that look similar (**Photo 4**). You should be able to recognize skulls and lower jaw bones. The feet may be intact or may be separated into the individual tiny pieces. You should be able to find vertebrae, ribs, leg bones, and pelvic bones. Sort out the pieces and determine how many animals were eaten to create the one pellet (**Photo 5**). (Hint: each animal will only have one skull and two lower jaw bones).

Use a book on mammals that includes drawings or photos of bones and see if you can determine what kind of animal bones you have found. Bones found in owl pellets commonly include those of rodents and shrews. You may also find bones of birds and insect exoskeleton pieces.



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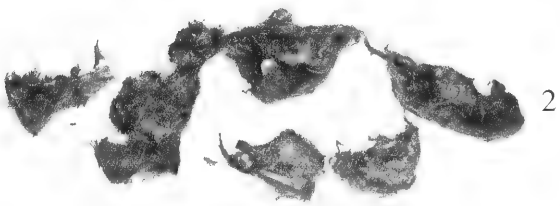

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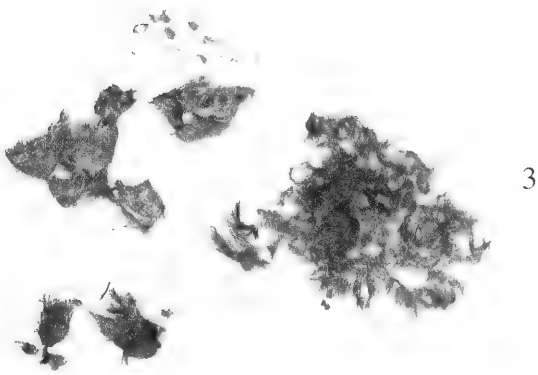

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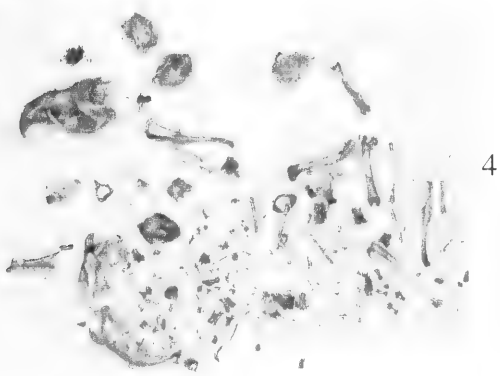

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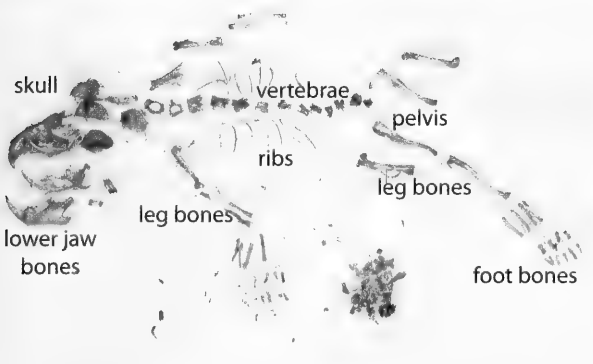


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Labeled skeleton by Carolyn Nixon, INHS Office of the Chief

Photos by Carolyn Nixon and Michael Jeffords, INHS Office of the Chief

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# Waterbird Use of Wetlands

*continued from front page*

breeding waterfowl ranged from 0.0 to 16.6 pairs/ha ($\bar{x} = 1.9 \pm 0.5$ [SE]), and 16 species of wetland birds were identified as breeders on restored wetlands. The density of waterfowl broods ranged from 0.0 to 3.6 broods/ha and averaged $0.5 \pm 0.1$ (SE). The majority of broods were Wood Ducks (39%), Canada Geese (32%), and Mallards (22%). Thus, many CREP wetlands were used by a variety of waterbirds during spring migration, nesting, and brood-rearing, clearly providing additional habitat for wildlife.

We also modeled how spatial, physical, and floristic characteristics of CREP wetlands were related to their use by waterbirds. The models that best explained species richness, the amount of use during migration, and waterfowl brood density included only the level of hydrologic management (i.e., none, passive, or active). For example, active management was associated with 858% greater use-days during spring than sites with only passive water management. Sites where hydrology was passively managed also averaged 402% greater species richness than sites where no hydrologic management was possible. In addition to the hydrologic management model, models including vegetation cover also were good predictors of waterfowl brood density. The density of waterfowl broods was greatest at sites where cover by wetland vegetation was about 30%. Models that accounted for vegetation quality and characteristics of the surrounding landscape ranked lower than models based solely on hydrologic management or vegetation cover. Placement and clustering of sites may be critical for maintaining populations of some wetland bird species, but these factors appeared to be less important for attracting migrant waterbirds in our study area. It is obvious that wetland restorations must contain water to attract waterbirds. However, when considering which investment in CREP will most benefit waterbirds, our results indicate that active restoration through initial engineering to establish and sustain a functional hydrology outweighed factors related to the landscape context of restoration sites.

*Benjamin J. O'Neal, Edward J. Heske, and Joshua D. Stafford, Division of Ecology and Conservation Sciences*

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ILLINOIS NATURAL HISTORY SURVEY
1858 to 2008
150 years
Reports
ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Spring 2008
No. 395

INSIDE



# The Year of the Survey

In the Far East, each and every year has a designation—the Year of the Dragon, the Year of the Tiger . . . they conjure up vivid images of dancing dragons, cavorting tigers, and more. Well, hold on to your hats, because 2008 is the Year of the Survey! The Illinois Natural History Survey is officially 150 years old and we are celebrating this milestone. Everyone is invited and we've planned a series of special events to commemorate natural history, natural resources, and the underlying science for which the survey is noted.

Our official celebration will be on Friday and Saturday, September 26–27 at the survey's South Research Park location in Champaign. We've planned our events to reach the entire range of our clientele—natural resource managers, politicians and government officials, fellow scientists, and, especially, that most valued of Illinois resources, it's citizens. All are invited to attend each and every event or pick and choose those that have individual appeal.

We begin with an event suitable for those who would like to know the status of Illinois' natural resources—a scientific symposium entitled *Conservation of Natural Resources in the 21st Century: The View From Illinois* that will run all day Friday September 26 at the new I-Hotel and Conference Center, 1800 South First Street, Champaign. We will feature a variety of speakers from Illinois and beyond, and conclude with our distinguished guest, Dr. Peter Raven, Director of the Missouri Botanical Garden and world authority on biodiversity issues. The event is free, but on-line registration is requested.

Logo courtesy of Carolyn Nixon, INHS Office of the Chief

Two events designed for families and a more general audience are scheduled for Saturday September 27. We have invited British author, TV personality, and renowned herpetologist Mark O'Shea to present "Serpents, Sorcery and Snakebite in Papua New Guinea, the Land of the Unexpected" at the I-Hotel in the morning. This should be a great event for all ages. Following the O'Shea presentation, INHS will have a Natural History Expo for families at its new headquarters (1816 South Oak St., Champaign) that will feature numerous interactive exhibits and displays that showcase the science of the survey. Our centerpiece will be the world-renowned insect collection of Dan Capps, an insect collector extraordinaire, fresh from his most recent visit where he was featured at Walt Disney World/Epcot Center, Florida. The event will run from noon until 6 p.m. and is free.

Biologists have been traversing Illinois from north to south and east to west for only 40 years less than it has been a state—since 1858! As permanent momentos of our 150th Celebration, we are producing two new books that will be for sale during the celebration.

*Biologists in the Field* is a collection of anecdotes, essays, short stories, and perceptions from 150 years of field biology

*Continued on back page*

# 150 Years of Service to the State

From its origin as a small group of educators and amateur naturalists in 1858, the Illinois Natural History Survey (INHS) has evolved into a pre-eminent state biological survey with the most complete collection of Illinois plant and animal specimens of any institution in the world. Now, a century and a half after its birth as the Illinois Natural History Society, INHS continues to serve the original mandate to create a comprehensive survey of the state's biological resources, to maintain a representative collection of plants and animals for education and research, and to disseminate new knowledge to the public.

Much like the organisms in the natural world that it studies, the survey has metamorphosed in several stages from a small cadre of unpaid volunteers to a large organization with more than 200 professional researchers and support staff. It is comprised of nine field stations throughout the state and several research and administrative buildings at the University of Illinois. The INHS Biological Collections, serving as the "biological memory" of the state, contain more than 9 million plant and animal specimens supported by more than 450 ongoing research projects. In 2007, INHS scientists generated some 170 peer-reviewed papers published in scientific journals, 225 technical reports to contracting agencies, and many news articles, book chapters, Internet pages, book reviews, posters, and pamphlets. The public was kept up to date with current research through 700 presentations by our scientists to schools, colleges, museums, private interest groups, and government agencies.

Naturally, an organization that can cast its net so widely did not spring into existence fully formed. Creating the Illinois Natural History Survey took imagination, foresight, some luck, and not a little effort and time.

Entomologist Cyrus Thomas of Carbondale was the first to propose a "state natural history society." He planted this seed in 1857 at the State Teachers Association annual meeting at Decatur. His timing must have been good because on June 30 of the next year (1858) a meeting was convened at the Illinois State Normal University (now Illinois State University) to form a natural history society. Meeting participants adopted a constitution which specified dues, membership requirements, and the society's officers including president, nine vice presidents, treasurer, secretary, librarian, and museum curator. The secretary was given charge of collecting and exchanging specimens, which were to be placed in the museum at the State Normal University.

*Founders Hall at the State Normal University, Normal, IL., first home of what was to become the Illinois Natural History Survey.* Photo from INHS Image Archives

By 1861 the state authorized the natural history society to establish its own museum at the university. In other words, ownership of the museum at the university was transferred to the natural history society. The society's charter stated that its purpose was "a scientific survey of the state of Illinois" as well as the creation of a library of scientific publications.

The society struggled to complete a comprehensive survey of Illinois' plants and animals. Without financial support from the state, the society's efforts were undertaken almost exclusively by unpaid volunteers. Consistency in the organization and maintenance of the collections was a chronic problem at the museum because no one person was employed to care for them. At the society's 1866 annual meeting, professor (and soon to be renowned explorer) John Wesley Powell suggested that the society solicit financial backing from the state. Powell addressed the Illinois General Assembly later that year and suggested an appropriation of $2,500 would cover the salary for a full-time curator as well as the costs for books and equipment.

The state House and Senate approved the appropriation in February of 1867 and the governor signed the bill into law immediately. Powell was rewarded for his efforts by being named the Natural History Society Museum's first curator.

Powell left the museum in 1872 to head the U.S. Geological Survey in Washington, D.C. Upon Powell's departure, continued state support of the museum was made contingent on transfer of

*Continued on next page*

# INHS to Be Incorporated in the University of Illinois

If all goes as proposed by Governor Rod Blagojevich, the Illinois Natural History Survey (INHS) will become part of the University of Illinois on July 1. The governor's plan would reorganize INHS and its sister state scientific surveys (Illinois State Geological Survey, Illinois State Water Survey, and Waste Management Research Center) into the Institute for Natural Sciences and Sustainability.

The proposed transfer of these organizations must be approved by the Illinois Legislature, the Illinois Board of Higher Education, and the U. of I. Board of Trustees and the Urbana-Champaign Senate.

The institute would serve as a focal point for applied energy, environmental science, and sustainability programs throughout the state, taking advantage of the surveys' complementary goals and missions of providing the scientific underpinnings for energy, sustainability, environmental policy and natural resource management, ensuring that the natural environment is preserved, managed, and developed to enhance the well being of the citizens of Illinois and the state's economic viability.

The surveys and the campus each have strong programs in natural resources, energy, and the environment. Their proposed institute will strengthen and combine the academic and educational programs of the campus with the state-focused research and outreach programs of the surveys. In addition to creating operational efficiencies among the surveys and university, the institute will expand opportunities for collaborative research as well as increased access to funding and the commercialization of technology.

According to U of I chancellor Richard Hermann, "The state surveys, long a part of our research activities, are truly significant contributors alone and through our joint work with them on issues of energy and sustainability. Notably, the work of the surveys has helped to address real-world problems for the people of the state of Illinois. This is fully in keeping with our land-grant mission, and it makes the University of Illinois the right intellectual home for the surveys. The governor's proposed action is most welcome and timely."

"This institute will combine the world-class expertise of survey and university scientists to provide the collaborative, interdisciplinary research necessary to address our modern, complex environmental problems," said David Thomas, Chief Emeritus of the Illinois Natural History Survey.

Incoming INHS Chief Brian Anderson says that working with the University of Illinois will help drive collaborative research.

"To tackle the really big questions in ecology, you really need multidisciplinary teams," he says. "This move (to the U of I) presents opportunities for broader collaboration."

Anderson believes the surveys can take the pure, theoretical science explored in a university setting and find practical applications for society.

*William Ruesink, INHS Interim Chief*

## 150 Years of Service

*continued from previous page*

the museum from the society to the state. Thus, the Illinois Natural History Society ceased to exist when the transfer occurred. The museum, however, continued to reside at Illinois State Normal University with Stephen A. Forbes as the new curator.

Forbes served as curator until 1877 when the museum became the Illinois State Museum and moved to Springfield. Forbes and his staff at Normal metamorphosed into the State Laboratory of Natural History, which was given responsibility for collecting materials for the state museum and for carrying out plant and animal surveys throughout Illinois.

In 1882 Forbes accepted an additional post as State Entomologist. So, the office of the state entomologist and the head of the state natural history laboratory were filled by one person and located in one venue. When Forbes accepted an appointment to Illinois Industrial University (now University of Illinois) at Urbana in 1885, he was allowed by the state to transfer his posts as state entomologist and natural history laboratory director as well. These offices took up residence in the Natural History Building at the intersection of Green and Mathew Streets at the UI campus.

The final metamorphosis of INHS took place in 1917 when the Office of the State Entomologist and Director of the State Laboratory of Natural History were combined into one organization, since known as the Illinois Natural History Survey. Stephen Forbes thus became the first of only seven "Chiefs"who have led the survey since it was established.

*Charlie Warwick, INHS Office of the Chief*

*The University of Illinois Natural History Building where INHS was relocated from Normal, Illinois, in 1885.* Photo from INHS Image Archives

# What Lies Ahead for INHS

In 1958 the the Illinois Natural History Survey (INHS) celebrated its hundredth anniversary. Chief Harlow Mills discussed the future for the survey at that time, and his comments are pertinent today.

*Throughout its century of existence, this organization has attempted to meet the needs of the economy of Illinois with an eye to the state's future requirements. The Board has appointed scientists with broad views and excellent training, men who were not satisfied with the present but who had a strong interest in the future. A half century ago Forbes wrote, 'I shall be governed by the reflection that we are today looking forward and not back—that we are preparing for the future and not studying the past—…'. The same fresh view should govern us at the end of 100 years. The problems in nature are ever changing, or, rather, our needs from and approach to nature are ever changing. There are new demands and new approaches. New research techniques require re-evaluation of what has been done. In agriculture there are new crops and new methods of raising them. New plant diseases appear. New insect pests invade the state. New demands are made for recreation. New advances in pure scientific knowledge must be made. All of these demands and approaches require the attention of the research specialist. All are inextricably bound up in the future.*

Mills was right about the demands for new approaches, and the result has been that our understanding of ecological processes and our sampling methodologies and statistical analyses are more refined and rigorous today than in the past. Remote sensing and continuous monitoring have provided us with large amounts of data that require extensive computational capabilities to analyze, capabilities that simply were not possible in the 1950s. Molecular ecology has advanced to the point where we can now differentiate small genetic changes in populations, and some of this information has become particularly pertinent as we look at the appropriate genetic stocks to use for habitat restorations.

Another change arises from our more complex mix of funding sources and the nature of our staffing. In the 1950s when Chief Mills wrote about the first 100 years, almost all of the survey's funding came from the state. Today almost 65% of our funds come from outside grants and contracts, which finance nearly three-quarters of our staff and many of our core functions. A significant amount of these outside funds are federal pass through funds, and these funds allow us to expand our efforts to do research that supports natural resource managers in the state. Our staff in the 1950s was mostly full-time members being paid by the state. Most of our professional scientists were men. Today a large number of women and international scientists make up our scientific staff and many of these are paid off of grants and contracts.

**Changes in a Publically Funded Institutions**

As the demands on our health care system, care of the elderly, and the increasing costs of our welfare and education systems continue to rise, less public funding is available for our universities and state research institutions such as the scientific surveys. To stay viable we will have to continue to explore alternative sources of funding and expand the amount of these funds to cover our operating budget. We will have to better market the services we provide and develop a stronger constituency that will encourage continued state and federal support of the scientific enterprise.

A significant strength of our survey is our association with the other scientific surveys (and with the University of Illinois), which collectively bring the kind of cross-disciplinary expertise needed to address our most pressing environmental, economic, energy, and natural resources related issues. We have explored with the other surveys the formation of an institute within the University of Illinois and this is presently being pursued for implementation by July 2008. This new structure should help us reduce administrative costs and make us more competitive in today's marketplace. Hopefully, the institute can attract foundation and private dollars to help offset the reductions that will likely continue to occur in state funding.

**Emerging Issues**

A number of environmental issues have risen to the forefront in recent years, and will drive much of the research we will do in years to come. **Climate change** has attracted the interest of scientists from around the world and creates the concern that plants and animals in our fragmented habitats can no longer move over climate gradients and thus are more subject to extinction from a variety of environmental stresses. **Invasive species** are spreading and becoming established at an increasing rate, and are having significant impacts on our natural areas and crops. Diseases such as West Nile Virus are being spread at an alarming rate, and have impacts on wildlife, domestic animals, and humans. **Urban wildlife issues** continue to become more significant as our populations spread into suburban forests and prairies, bringing wildlife and humans into closer contact. **Habitat fragmentation** is significant in both our terrestrial and aquatic systems, due primarily to roads, dams, suburban development, and extensive agriculture. This has led to fragmentation of populations and reduced gene flow among

*Continued on next page*

# We Have a New Chief!

Brian Anderson, assistant to the president at Lincoln Land Community College, will become the new chief of the Illinois Natural History Survey (INHS) on May 1.

He succeeds David Thomas, who retired at the end of February.

Anderson takes over at a time when the INHS and the other state surveys are being moved to the jurisdiction of the University of Illinois from the Illinois Department of Natural Resources.

Anderson told the *Springfield Journal Register*, "The surveys were renowned and continue to be outside the state," Anderson says. "It has kind of been a frustration of mine that the Illinois scientific surveys are better known outside the state than within Illinois."

"It's like people in Springfield don't visit the Lincoln sites," says Mike Conlin, director of DNR's office of resource conservation. People take it for granted.

"It is hands-down the best natural history survey in the United States," he says. "And I think it's recognized as that."

Anderson formerly served as the Illinois Department of Natural Resource's director of the office of resource conservation; before that, he directed the office of scientific research and analysis.

He has been at Lincoln Land Community College since July 2004, where he served as chair of the department of biological and physical sciences before becoming the assistant to the president for planning and institutional improvement two years ago.

He says working with the University of Illinois will help drive collaborative research.

Anderson says the survey can take the pure, theoretical science explored in a university setting and find practical applications.

"If it were easy, every state would have a system of scientific surveys, but they don't," he says. "All the parties recognize at this moment that the better home for the survey is the university."

The survey's main offices already are housed in Champaign, with a series of field stations located around the state, including Havana. Anderson says the survey's field stations are important for their ability to reach out to their communities.

"The University of Illinois realizes the value of the stations, being a conduit to getting the information people need and having local contacts," he says. "I would anticipate the survey field stations are going to play a primary role in that outreach and dissemination of information."

Photo courtesy of Illinois Department of Natural Resources

Anderson says the surveys give Illinois an edge when competing for research dollars and projects like the Future Gen power plant.

"There is no other state that has the breadth of surveys Illinois does," he says. "That in and of itself should set the stage for us to play a leadership role in issues like climate change and how to meet our energy needs."

*Compiled by Charlie Warwick, INHS Office of the Chief*

## What Lies Ahead for INHS

*continued from previous page*

populations. **Water issues** continue to increase in importance, as our demand for water from a variety of sources begins to impact our aquatic systems. While these problems have become severe in places out west, they are beginning to become significant even in water rich Illinois. **Alternative energy** strategies such as wind power and biomass will help our nation reduce its dependence on oil, but may have significant environmental effects that need to be addressed. The survey has initiated studies on the impacts of wind generation on birds and bats, and has also investigated the impact of biomass production.

As mentioned earlier, new and modified technologies are helping us better address some of our complex environmental issues. Remote sensing and the use of supercomputers to analyze large data sets are helping us better understand animal movements and behavior. Radar technologies are being used more to determine the migration patterns of flying animals and also their behavior around wind turbines. Molecular ecology advances are bringing us to the point of bar coding all species, and allow us to determine subtle genetic changes in populations.

The future for the survey has never been more exciting in its possibilities for breakthrough research and has probably never been more threatened in its reduced support from state government. But if we look to the past, we see that through good times and bad, the dedicated scientists and leaders of the survey have continued to do excellent work and to contribute significantly to our society. There is no reason that this success, even under adverse conditions, will not continue into the future.

*David L. Thomas, INHS Chief Emeritus*

# Division of Ecology and Conservation Sciences

Researchers in the INHS Division of Ecology and Conservation Sciences (DECS) investigate aquatic and terrestrial communities worldwide, and how these can best be conserved and restored. The division represents a merger of the former centers for Aquatic Ecology and Conservation (CAEC) and Wildlife and Plant Ecology (CWPE), both of which remain as sections, along with the newly-developed section for Field Stations and Ecosystems Science. We comprise approximately 17 professional, 36 research, and 40 technical scientists, along with 9 support staff and 123 students/affiliates. All are involved in diverse projects, but given space limitations we highlight but several of these below.

Habitat loss and overexploitation are major causes of wildlife population declines, and thus have been the subject of much research in our division. However, DECS scientists are also finding that infectious diseases have become not only a significant conservation and management issue but also a source of considerable public concern.

Illinois is a focal point for two burgeoning disease epidemics that directly impact both humankind and wildlife. DECS researcher Dr. Nohra Mateus-Pinilla (in collaboration with state/federal agencies and University of Illinois colleagues) is studying the epidemiology of Lyme disease, caused by a bacterium transmitted via infected ticks that feed opportunistically on a large number of mammalian species. In humans, the disease manifests itself as an initial rash with accompanying flulike symptoms; the bite is often accentuated by a characteristic "bulls-eye" inflammation (Fig. 1A). Prognosis for recovery is good if the disease is caught early, but quickly deteriorates when confusing symptoms postpone treatment.

DECS researchers note that contact between humans and disease vectors is exacerbated by the gradual deforestation accompanying suburban development and by the reduction in predators that control the small rodents which serve as disease reservoirs. Simultaneously, onset of global warming also contributes to elevated human infections by promoting environmental conditions that exacerbate vector-borne diseases.

Dr. Mateus-Pinilla and colleagues are also investigating chronic wasting disease (CWD), a transmissible central nervous system condition primarily among deer, elk, and moose caused by an ingested prion (proteinaceous infectious particle). First recognized as a syndrome in 1967 and as prion-transmitted in 1978, CWD is typified by behavioral changes and chronic weight loss leading to death (hence its name). It is but one of several diseases caused by prions: bovine spongiform encephalopathy (= Mad Cow Disease) and Creutzfeldt-Jakob disease in humans are two others. All develop slowly, affect brain/ neural tissue, and are currently untreatable and fatal.

For DECS researchers, deer hunts become the primary data source for CWD (Fig. 1B). Results indicate that horizontal disease transmission (i.e., kin-to-kin and via migration) is an important factor in disease propagation, but vertical (mother-offspring) transmission is also emerging as a serious but relatively unstudied aspect of CWD epidemiology.

*Figure 1A (left): Characteristic "bulls-eye" rash indicative of Lyme disease; 1B (right): Scientists extract tissues from a deer at a central Illinois checkpoint.* Image courtesy of Michael Douglas, INHS

Another line of conservation research being pursued in DECS is the manner by which the unregulated exploitation of sustainable energy sources is negatively impacting wildlife. For example, the accelerating development of wind energy is prompting conservation concerns about cumulative impacts between airborne, nocturnal creatures and 40-story wind turbine blades. DECS researchers studying songbirds protected by the Migratory Bird Treaty Act have found that utility-scale wind-energy facilities definitely impact bird populations, but surprisingly, also kill considerably more bats than anticipated. Monitoring these collisions in real-time is difficult in that they occur 100 meters up in the night sky. However, Dr. Ron Larkin of DECS (and his colleagues) utilize sophisticated stationary-beam and tracking radars (Figs. 2A, B) to not only document migratory pathways of nocturnal, flying creatures but also to quantify their behaviors (and inadvertent collisions with rotating blades (Fig. 2C) at wind-turbine sites. These data help to delineate enigmatic migration routes and local movement corridors, but also to balance sustainable energy production by a "green" and growing industry against an ongoing conservation concern.

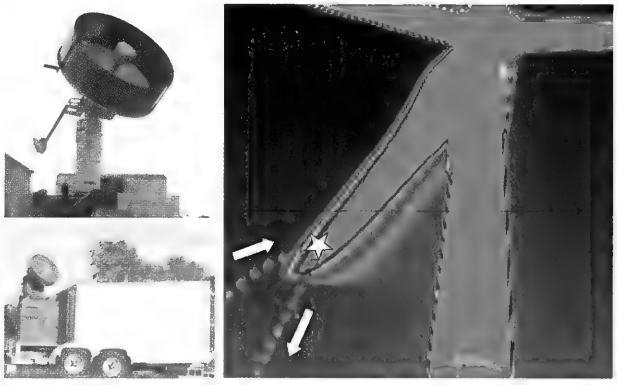


*Figure 2A (left-top): Stationary beam radar (Illinois Natural History Survey); 2B(left-bottom) Mobile tracking radar equipment (Illinois Natural History Survey); 2C (right) Real-time collision between bat and turbine blade (photo: Jason Horn).* Image courtesy of Michael Douglas, INHS

While the researchers and their programs depicted above provide interesting windows into our division, other such endeavors are of equal interest and, indeed, may provide a future opportunity for a continuing exploration into the varied scientific investigations ongoing within our division.

*Michael Douglas, Director DECS*

# Division of Biodiversity and Ecological Entomology


Image courtesy of Geoff Levin, INHS

The Division of Biodiversity and Ecological Entomology (DBEE) consists of three sections: Biodiversity, Biotic Surveys and Monitoring, and Ecological Entomology. Staff in these groups conduct research and outreach in a wide variety of topics related to the biology, distribution, and conservation of organisms in natural and human-dominated ecosystems.

Much of the research in DBEE focuses on systematics, the science of uncovering the evolutionary history of organisms and applying that to their classification. We have expertise in most major groups, including plants, fungi, and invertebrate and vertebrate animals. This work reveals what organisms make up our flora and fauna. It also informs much of the rest of the survey's work, because identifying organisms correctly and understanding their relationships is the first step in ecological and conservation research.

Biological inventories represent another major part of our work. Some of these inventories are statewide or regional, whereas others are targeted at specific natural areas. Often we focus on threatened or endangered species, or groups we suspect may be declining, like the pleurocerid snails of Illinois being assessed by Jeremy Tiemann and Kevin Cummings. Sometimes the organisms are so poorly known we do not know their status, as with mushrooms and other macrofungi in prairie grove remnants, which Dr. Andy Miller is inventorying. Many inventories are conducted in the context of highway and bridge projects with funding from the Illinois Department of Transportation and the Illinois Toll Highway Authority.

Both systematic studies and inventories produce scientific specimens that become part of the survey's permanent collections, which are managed by DBEE staff. Dating back to the mid-nineteenth century and now numbering about 9 million specimens, the survey's collections document the historical and current distributions of the state's flora and fauna. More information on the survey's collections and their uses can be found at the survey's Web site.

Ecological studies of native habitats are another major focus of DBEE staff. For example, Dr. John Taft has documented significant "edge effects" in prairie remnants, in which the outer portions show decreased native species diversity but increased exotic species diversity. These results can guide acquisition and management of Illinois' highly imperiled prairies. In another study of prairies, Drs. Brenda Molano-Flores and Chris Dietrich are exploring the use of leafhopper diversity to assess prairie health. Traditionally, only plant diversity has been examined in prairies, but it is clear that leafhoppers and other insects are vital parts of these communities and offer independent measures of how well they are functioning.

Another set of ecological studies focuses on individual species, especially those that are either declining or invasive. Declining species we are studying include cave-dwellers like the Illinois cave amphipod (Dr. Steve Taylor), sand-restricted species like the Illinois mud turtle (Dr. Chris Phillips), and rare prairie plants (Dr. Molano-Flores). Dr. Lee Solter, like many of our scientists, studies both declining and invasive species. She is trying to determine if microsporidia (a group of highly reduced, parasitic fungi) are responsible for the rapid decline of bumblebee populations across North America, and also exploring whether other microsporidia can be used to control the invasive gypsy moth.

A significant part of our work is directed not at native communities, but at human-dominated ecosystems. The division has a long history of agricultural research. Current projects include a study by Dr. Cathy Eastman, in collaboration with University of Illinois staff, aimed at finding the most effective cropping methods for growers making the transition from traditional to organic farming, and Dr. Joe Spencer's work on the behavior of the western corn rootworm in relation to crop rotation and genetically modified corn. We also have an active medical entomology laboratory, currently led on an interim basis by Dr. Richard Lampman, investigating mosquitoes and the diseases they carry, particularly West Nile Virus.

Clearly the scientists in DBEE form a diverse group. This diversity, by bringing together basic and applied research in systematics and ecology, facilitates wide ranging synthetic studies. Together, DBEE staff are providing information critical to understanding and conserving the flora and fauna of Illinois, managing agricultural ecosystems, and protecting human health.

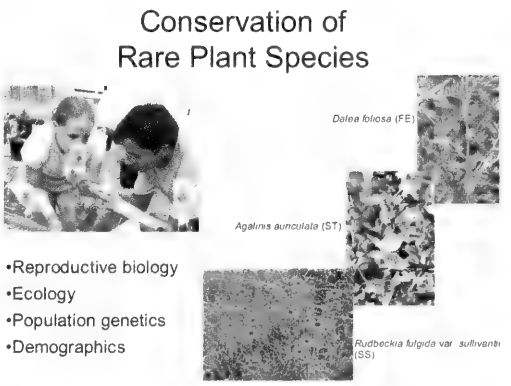



Image courtesy of Geoff Levin, INHS

*Geoff Levin, Director DBEE*

# *In Memoriam*: Glen C. Sanderson

Well-known wildlife researcher and administrator Dr. Glen C. Sanderson passed away on March 22, 2008. He was 85 years old. Dr. Sanderson had a remarkable career at the Illinois Natural History Survey that began in 1955. Although he retired in 1990, he maintained a very active emeritus position until his death.

Sanderson was born in 1923 in Wayne County, Missouri. He served as a 1st Lieutenant in the U.S. Army in the South Pacific during World War II. After the war, he earned a Bachelor of Science degree in agriculture and wildlife and a Master of Science in zoology at the University of Missouri. He received a doctorate from the Department of Animal Science at the University of Illinois.

Dr. Sanderson worked as a game biologist with the Iowa Conservation Commission from 1949 to 1955. He was employed by the Illinois Natural History Survey in 1955, promoted to the rank of Professional Scientist in 1963, and made Director of the Center for Wildlife Research in 1964, a position he held until retirement in 1990. He was appointed adjunct professor at Southern Illinois University in 1964, and professor of zoology and member of the faculty of the Graduate College at the University of Illinois in 1965. He advised numerous candidates for advanced degrees, taught classes in wildlife ecology at the University of Illinois, and lectured at numerous colleges and universities. In 1989, he was promoted to the distinguished rank of Principal Scientist, a level only three other scientists held at that time in the then 133-year history of the survey.

Dr. Sanderson's primary area of scientific expertise was mammalogy, a field where he is highly regarded nationally and internationally. He was considered a world authority on the biology and ecology of the raccoon. In the early 1960s, he headed an important study on rabies in raccoons, skunks, and foxes.

Dr. Sanderson was a highly respected waterfowl biologist and acquired national and international prominence as an authority on lead poisoning in waterfowl. He has been characterized as a giant in the crusade for nontoxic shot.

For almost 30 years, Dr. Sanderson played the lead role in cooperative efforts to preserve two remnant flocks of critically endangered native Illinois Prairie Chickens. The combined efforts of the Illinois Chapter of The Nature Conservancy, the Illinois Department of Conservation, and the Illinois Natural History Survey resulted in innovative approaches to land acquisition and management at the national level.

The publication record of Dr. Sanderson is exemplary, considering that he served as the administrative head of the wildlife center for 26 years. He had a unique talent for writing and editing. Sanderson wrote more than 90 scientific publications and numerous popular

Photo from INHS Image Archives

articles and reports. He edited three books: *Wild Turkey Management: Current Problems and Programs, Midwest Furbearer Management*, and *Management of Migratory Shore and Upland Game Birds in North America*. He also wrote 15 chapters for books of others, and edited and made significant contributions to Dr. Frank Bellrose's, Dr. Harold Hanson's, and Dr. Stephen Havera's award-winning books. Additionally, in his spare time, Sanderson served as editor of the *Journal of Wildlife Management* in 1971 and 1972—his efforts were described as "terrific."

Dr. Sanderson was a member of several professional societies at the local, state, national, and international levels. He served on and chaired numerous national committees. He received many professional honors, including the Aldo Leopold Award, the most prestigious professional award of The Wildlife Society. His awards also included the Honorary Life Membership and regional and state Professional Awards of Merit of The Wildlife Society, the Oak Leaf Award of The Nature Conservancy, Conservationist of the Year from the American Motors Company, and the Association of Great Lakes Outdoor Writer's Golden Glow Public Service Award. In 2007, Sanderson was inducted into the Illinois Conservation Foundation's Hall of Fame in recognition of his lifelong commitment to natural resources protection and outdoor recreation in Illinois. Glen was a long-time member of the Board of the Champaign County Design and Conservation Foundation, and served as chairman of its Land Trusteeship and Memorial Committee, which supervised the Wandell Tree Trust, and provided hundreds of trees to cities, villages, and park districts in Champaign County.

Through a productive and distinguished career, Dr. Glen C. Sanderson contributed enormously to the international wildlife profession. Sanderson's unwavering dedication to wildlife research was a shining example to peers throughout the profession. He was considered a premier leader and spokesman for wildlife and other conservation issues by state agencies and government. During his almost three decades of exemplary leadership and guidance as center director, he elevated the Illinois Natural history Survey to the forefront of wildlife research.

As director, Sanderson commanded the utmost respect and loyalty from his staff and acquired their unanimous support. He set high standards for his staff by working harder than anyone else, by exemplary conduct, and with his willingness to take the time, skill, and energy to assist them. He was selfless in that he always placed the research of others ahead of his own. Sanderson was a top-notch administrator, but also a colleague, role-model, and friend to his staff. He was never too busy to help but took little credit for his benevolence. Dr. Sanderson was the "silent soldier" behind the accomplishments of the survey's wildlife programs. For those of us fortunate to have worked with and known Dr. Sanderson, he was our gold standard and our champion.

Dr. Sanderson and his wife of 60 years, Beverley, were blessed with a son, Bill, and daughter, Laurie. The family requests memorials be made in Glen's honor to: University of Illinois, INHS Waterfowl Research Station, and mailed to Illinois Natural History Survey, P.O. Box 590, Havana, Illinois 62644.

*Stephen P. Havera and April Burgett, INHS Forbes Biological Station*

# David L. Thomas Ends Long Career in Conservation

Illinois Natural History Survey (INHS) Chief Dr. David L. Thomas retired on February 29, 2008.

Dr. Thomas has served as Chief of the INHS, a division of the Illinois Department of Natural Resources, since 1997. Previously, he served as the Director of the Illinois Waste Management and Research Center (WMRC) from 1985–1997.

Since his arrival at the survey, Dr. Thomas has focused on several issues, including those related to invasive exotic species. In 2000, he was the nonfederal co-chair for the Research and Information Workgroup for the National Invasive Species Advisory Committee, a council that coordinates federal activities regarding invasive species. He has been on a number of Illinois Department of Natural Resources invasive species committees and workgroups and currently serves as a member of the Illinois Invasive Plant Species Board.

Dr. Thomas, a Buffalo, New York native, has been involved with the University of Illinois in a variety of capacities. He presently represents the survey as a member of the Arboretum Board and also as a member of the Environmental Council. He is a board member of the National Great Rivers Research and Education Center, which is a collaborative effort among the UI College of ACES, Lewis and Clark Community College, and the INHS. This center promotes research, education, and a better understanding of large river issues, and is in the process of developing a state-of-the-art field station at Alton, Illinois.

Restoring the Illinois River has been another focus for Dr. Thomas. He served on the Science Advisory Committee to the Illinois River Coordinating Council and The Nature Conservancy Science Advisory Committee for the restoration of The Emiquon National Wildlife Refuge, one of the largest floodplain restoration projects in the United States.

He also chaired the American Fisheries Society committee addressing the Farm Bill 2002. The committee's work concluded with a "Pending Legislation Opinion" article in the November 2001 issue of *Fisheries* magazine. Recently, he became a board member for the Chicago Wilderness Trust. Chicago Wilderness (CW) is an alliance of public and private organizations working together to preserve and manage the natural ecosystems of the Chicago region. He was previously an active member of the CW Steering Committee.

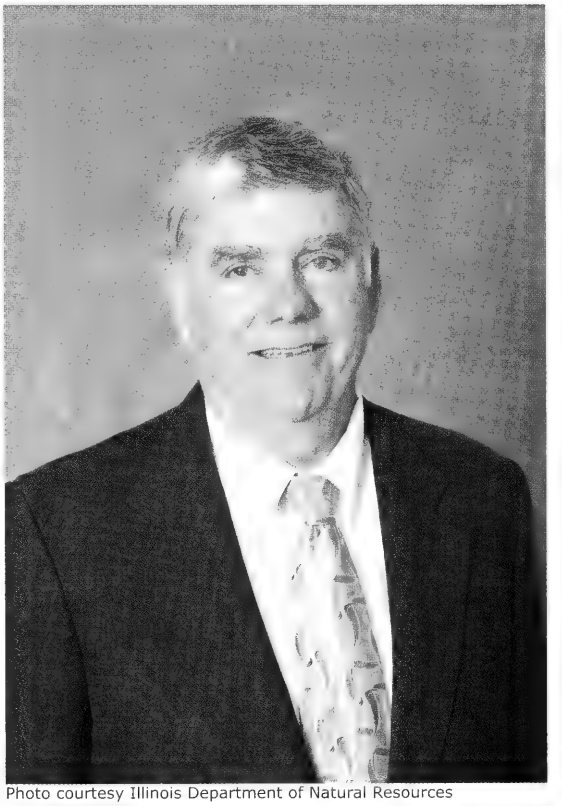


Photo courtesy Illinois Department of Natural Resources

Dr. Thomas has been active not only in Illinois but also nationally and internationally in the area of pollution prevention and sustainable development. He was on the first governing board for the National Pollution Prevention Roundtable from 1990 to 1994 and was Chair of the Board of Directors from October 1993 to September 1994. He represented the roundtable on EPA's American Institute of Pollution Prevention (AIPP) from 1992 through 1999.

His retirement doesn't signify the end of his involvement with INHS. Dr. Thomas plans to continue fundraising efforts for the survey's upcoming 150th Anniversary Celebration and on some research projects. He plans to remain active in various environmental causes.

*Marsha Hatchel, INHS Office of the Chief*

*Species Spotlight*

# What or Who Is a Survey Scientist

Susan Post

Does the word "scientist" conger images of someone dressed in a clean white lab coat, using a variety of glassware full of colorful, bubbling liquids? While that may have been an accurate description of perhaps a third of survey scientists 30+ years ago, the scientist of today is more likely to wear jeans and some sort of nice nature theme T-shirt during the days in the office. The field attire is usually field pants that dry quickly, an old nature theme T-shirt covered with a long-sleeved shirt, and a hat. Most of our jobs require that we are actually in the field. Perhaps Indiana Jones-type figures come to mind?

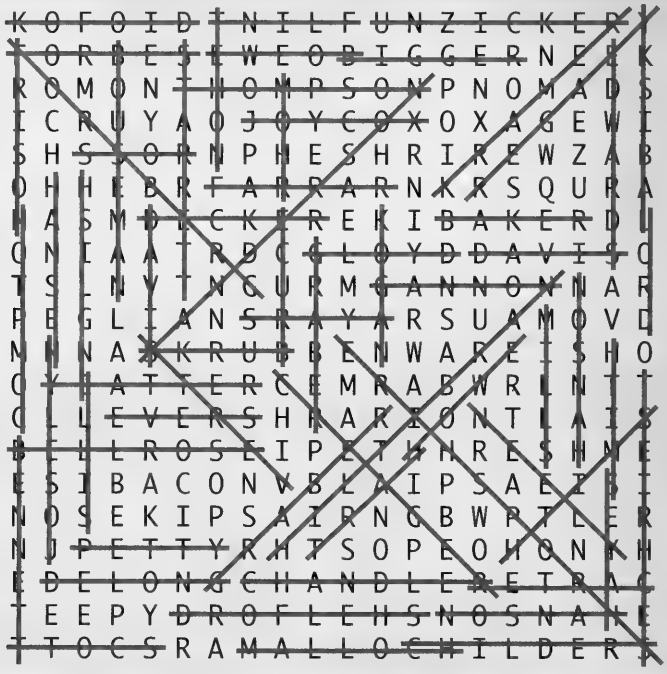
*The common INHS researcher* (Researcheri inhsensis vulgaris) *in its natural habitat.* Photo by Michael Jeffords, INHS Office of the Chief

Ah, the field. To the INHS office staff or other colleagues that never get to experience "the field," the term must seem a magical place where we disappear with tape measures, nets, plant presses, jars, bags, traps, PVC measuring squares, and a variety of other implements to collect data. They see us leaving with smiles, most always laughing and joking. When we return our clothes reek of insect repellant and sunscreen, there is usually a trail of dirt through the clean hallways of our buildings, and our data pages are smudged with stains or warped from the humidity, but we still are laughing and joking. A colleague once quipped "the best day in the office is far worse than the worst day in the field."

To be a field biologist is, well, special. We are an interesting lot, capable of incredible stubbornness in the face of adversity and always willing to do whatever it takes to collect "the data." Ah the data, always first and foremost in our minds. Survey scientists know what it's like to spend a frigid night in on open boat shocking fish, crawl through wet, dark cave passages as the sound of thunder rolls through the blackness, stare numbly in the hot, close forest at that last quarter meter transect of the day, or summit remote mountain passes in central Asia with nothing between them and disaster but a cranky, aging truck. Yet, it's important to remember that field biologists (scientists) are just people, after all, but people who are living their dreams.

How many people actually get to live their dream? As a child many of us chased butterflies, fished, hunted with Dad, or just explored the out-of-doors. We are still outside, but now answering important questions. What organisms occur along a certain corridor? How do we increase a certain organism's population size? What is causing a species to decline? How many ducks migrate through Illinois? What is the best way to restore land back to its "original" state? How do we get rid of unwanted invasive species? The days "in the field" may be long, uncomfortable, full of tedium, but we are still out there, alone or in small groups, having fun in places where we have never lost our passion for discovery.

Answers to Word Search on the following page.



# Natural History Survey Scientist Word Search

Below is a list of just a few of the eminent authors of Illinois Natural History Survey publications from the past. See if you can find their LAST names in the word search. The names may be forwards, backwards, upright, upside-down, or diagonal. If the same last name appears more than once on the list, it will appear more than once in the word search.

James Sterling AYARS
Frank C. BAKER
Frank C. BELLROSE
George William BENNETT
J.H. BIGGER
Gideon H. BOEWE
John K. BOUSEMAN
Willis N. BRUCE
B.D. BURKS
J. Cedric CARTER
Stewart C. CHANDLER
William F. CHILDERS
Charles C. COMPTON
D.B. CREAGER
J.E. DAVIS
Jonathan J. DAVIS
George Clemens DECKER
Dwight Moore DELONG
William R. EDWARDS
Jack A. ELLIS
Lester Lamar ENGLISH
Robert A. EVERS
Milton Dyer FARRAR
W.P. FLINT
Stephen Alfred FORBES
J.L. FORSBERG
Theodore H. FRISON
Norman GANNON
Leonora K. GLOYD
Jean W. GRABER
Richard R. GRABER
Donald Frary HANSEN
Harold C. HANSON
William R. HANSON
Charles A HART
William P. HAYES
Robert C. HILTIBRAN
Wayne L. HOWE
Elbert R. JOYCOX
G. Blair JOSELYN
Charles A. KOFOID
Marcos KOGAN
John Paul KRAMER
Ronald F. LABISKY
Rexford D. LORD, Jr.
John Russell MALLOCH
Harlow Burgess MILLS
Carl Otto MOHR
Daniel NEELY
Howard Bliss PETTY
Herbert Holdsworth ROSS
Milton W.S. SANDERSON
Thomas G. SCOTT
Ralph E. SECHRIEST
Victor Ernest SHELFORD
L.H. SHROPSHIRE
Frank SMITH
Philip W. SMITH
William C. STARRETT
Leo R. TEHON
David H. THOMPSON
John D. UNZICKER
Bobbie J. VERTS
Lee E. YEAGER
Ralph E. YEATTER

K O F O I D T N I L F U N Z I C K E R Y
F O R B E S E W E O B I G G E R N E E K
R O M O N T H O M P S O N P N O M A D S
I C R U Y A O J O Y C O X O X A G E W I
S H S S O R N P H E S H R I R E W Z A B
O H H E B R F A R R A R N K R S Q U R A
N A S M D E C K E R E K I B A K E R D L
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ILLINOIS
NATURAL
HISTORY
SURVEY
1816 South Oak Street,
Champaign, Illinois
61820 USA



# Celebration

*continued from front page*

Illinois Natural History Survey Reports is published quarterly by the Illinois Natural History Survey, 1816 South Oak Street, Champaign, IL 61820. Headquartered on the campus of the University of Illinois at Urbana-Champaign, the Survey is a division of the Illinois Department of Natural Resources

INHS Reports is edited by Tom Rice and Charlie Warwick and printed on recycled and recyclable paper. Design by Otto-Walker Communications.

in Illinois, all written by INHS biologists. The stories feature everything from Stephen Forbes' early letters to his wife Clara, to misadventures in Illinois and around the world. We have invited UI entomologist May Berenbaum to write the foreword and nature writer Stephen Lyons to conclude with an epilog.

The second book, *Canaries in the Catbird Seat: The Past, Present, and Future of Biological Resources in a Changing Environment,* is a compendium of articles that give the current status of many of the living resources of Illinois, including its forests, prairies, wetlands, and selected groups of plants and animals. The coffee table style book will feature color photos, charts, and other materials to provide an up-to-date look at natural resources in Illinois.

So mark your calendars for 2008 as The Year of the Survey. We invite you to share our birthday celebration with us and look forward to seeing all of you at the various events designed to showcase 150 years of scientific effort at INHS. For additional information, check out the INHS Web site: http://www.inhs.uiuc.edu/.

*Michael Jeffords, INHS Office of the Chief*

ILLINOIS NATURAL HISTORY SURVEY
150 years 1858 to 2008
Reports
ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Summer 2008
No. 396

INSIDE





# The House Mosquito *Culex pipiens*: A Threat in Your Backyard

The house mosquito (*Culex pipiens* Linnaeus) is the most widely distributed mosquito species in the world, and is encountered in all geographic regions except Antarctica. The name "house mosquito" comes from its close association with human settlements. Although *Culex pipiens* breeds in rural areas including marshlands, swamps, temporary ponds, and irrigation schemes, this mosquito thrives particularly well under urban conditions. Gravid females lay their eggs in the form of rafts primarily in polluted (high organic content or eutrophic) water in waste tires, abandoned cans, clogged roof gutters, barrels, birdbaths, or any place that can hold water long enough for eggs to hatch and the aquatic stages to complete development. This allows them to take advantage of habitats many mosquito species avoid. After emergence, adults will frequently enter houses and feed on humans during the night. The advent of air conditioning greatly reduced the presence of many mosquito species in modern homes, but species like *Culex pipiens* still remain near residential areas due to the abundance of urban larval habitats, including catchbasins. This species tends to feed within a couple hours after dusk and before dawn, although environmental conditions can shift the peak feeding until later at night.

*Culex pipiens* is so widespread in North America that it is difficult to believe that this mosquito species was unknown to the Americas in the pre-Columbian era. It was introduced to America from Africa and Europe on ships, probably on several occasions, during the slave trade and European colonization. In a short period of time, these mosquitoes were able to disperse throughout the entire New World.

*Culex pipiens* has been a difficult "nut to crack" for taxonomists and vector biologists. Early studies of the biology of this mosquito often resulted in conflicting conclusions. While some researchers described this mosquito as an annoying fierce man-biter, others viewed it as an insect with little or no interest in humans, describing it as primarily a bird feeder. Differences in feeding behavior and diapause capability of the northern form and southern form of this species led to the recognition of the group as a species complex (sibling species). Despite their ecological and behavioral differences, adult females and immature stages of the *Culex pipiens* complex cannot be reliably distinguished based upon their morphology alone. The only reliable morphological character that discriminates within the group is the DV/D ratio of male genitalia. This is an estimate of the distance between the tip of the dorsal (D) arm and the ventral arm (V) and the distance separating the two dorsal arms (D). (See photo on next page). The DV/D ratio is not useful for identifying adult females (see photo above), which is the only life stage that takes blood meals and thus can transmit diseases.

*Female of* Culex pipiens pipiens. Photo by Michael Jeffords, INHS Office of the Chief

The northern house mosquito (*Culex pipiens pipiens* L*)*, and the southern house mosquito (*Culex pipiens quinquefasciatus* Say) are the most common forms of the complex. The northern house mosquito has a DV/D ratio <0.2,

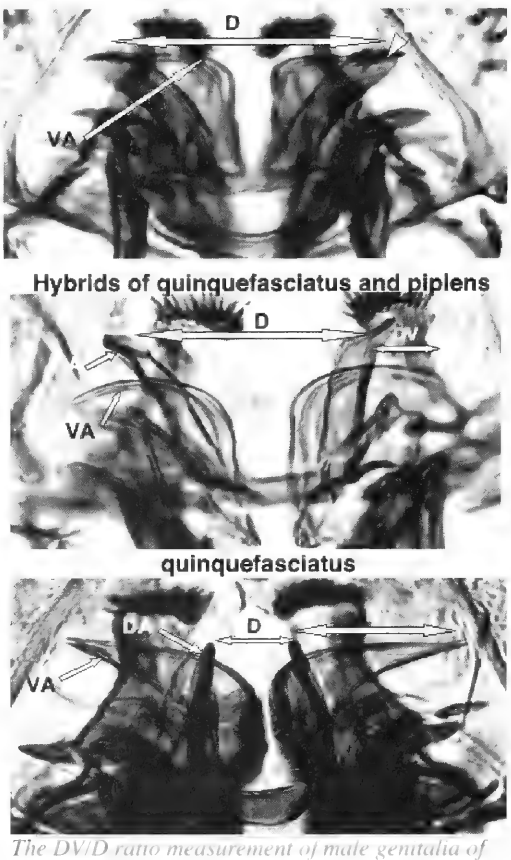
*Continued on next page*

# House Mosquito

*continued from previous page*

feeds predominantly on birds, and is found in temperate regions. Inseminated females enter reproductive diapause during the winter. Another form morphologically indistinguishable from *Culex pipiens pipiens* was named *Culex pipiens molestus* because it was found to "molest" people. Its distribution overlaps with that of *Culex pipiens pipiens*. *Culex pipiens molestus* Forskal breeds all year around in underground structures and is known for the ability to mature its first set of eggs without a bloodmeal. *Culex pipiens quinquefasciatus* (DV/D rato > 0.4) is the tropical form of the complex. This form does not undergo reproductive diapause and can also breed all year long in tropical areas. In 1957, Ralph Barr showed that in the United States only the northern house mosquito is found above 39°N latitude. At latitudes below 36°N, only the southern house mosquito is usually encountered. Hybrid forms (DV/D ratio between 0.2 and 0.4) have been recorded in nature. To date, much of the debate centers on whether the various members of the *Culex pipiens* complex are species or introgressed biological forms. The consequence of our inability to accurately identify these mosquitoes at the species level is a lack of knowledge of the biology and behavior of these vector mosquitoes. Thus, the debates on the taxonomy of *Culex pipens* complex extend well beyond that of an academic exercise. Beside their nuisance, *Culex pipens* mosquitoes act as vectors of debilitating diseases such as human lymphatic filariasis, dog heartworm, Rift Valley Fever, Saint Louis and West Nile Encephalides. It is well established that the feeding behavior of arthropod vectors determines their ability to transmit diseases to their hosts. Recent studies have suggested that hybridization within the *Culex pipiens* complex may have caused a shift in host feeding behavior, which contributed to the dissemination of West Nile Virus in North America. Therefore, the epidemiological implications of the complex as an enzootic (bird-to-bird transmission) and a bridge vector of diseases to mammals, including humans, require a means of easily identifying these species.

The medical entomology laboratory at the Illinois Natural History Survey has studied various aspects of the biology of the house mosquito in Illinois for many years, including attraction to various infusions used in traps, spatial and temporal abundance in tires and containers, seasonal population dynamics, and recently arbovirus infection rates. Unfortunately, the literature is full of studies pooling the species within the *Cx. pipiens* complex as well as species morphologically similar (*Cx. restuans* and *Cx. salinarius*) during abovirus surveillance programs. In order to improve our understanding of the role specific species play in the transmission of arboviruses, we developed a novel real-time polymerase chain reaction technique that allows the reliable identification of both male and female *Culex pipiens* as well as *Cx. restuans*, *Cx. salinarius*, *Cx. tarsalis*, and *Cx. nigripalpus*. Using this technique, we detected a high frequency of hybrids between the northern and southern house mosquitoes in Champaign-Urbana (40.05°N), thus demonstrating for the first time a northward expansion of the hybrid zone from the initial 39°N upper boundary reported by Barr in 1957. This new tool will also help us to determine the species-specific contribution of the sibling species in the transmission of West Nile Virus. The key elements of arbovirus transmission include vector competency (ability to transmit an infective dose of pathogen), feeding rate on different vertebrates (including man), and vector abundance. In the long term, our laboratory seeks to elucidate the complex ecological and genetic factors that determine the ability of mosquitoes to transmit diseases as well as provide an ecological focus for vector abatement and mosquito-borne disease risk assessment.




*The DV/D ratio measurement of male genitalia of the house mosquito* Culex pipiens *complex. DA, dorsal arm; VA, ventral arm; D, distance between the dorsal arms; DV, distance between the tip of the ventral arm and the dorsal arm.* Photo by Y.O. Sanogo, INHS Division of Biodiversity and Ecological Entomology

*Yibayiri O. Sanogo and Richard Lampman, Division of Biodiversity and Ecological Entomology*

# Effects of Stocked Sport Fish on Aquatic Food Webs

The stocking of predatory sport fishes for recreational purposes is a common fisheries management practice that has been utilized for over a century. Despite the frequency of sport fish stocking, little research has focused on the food web and community responses of increasing predator diversity and abundance. This is particularly true in lakes with existing predator populations because the majority of research on predator introductions has focused on effects in previously predator-free systems. Many questions remain regarding the ecological effects of stocking, including the prevalence of cascading trophic interactions, which alter community structure, and the possible effects of stocked fish on existing predator populations and fisheries.

Case studies and available theory dealing with trophic interactions and predator stocking suggest there are many possible effects on aquatic communities that receive stocked fish. Cascading effects such as changes in nutrient cycling, increased top-down control of primary production, changes in habitat coupling, and indirect effects due to behavioral responses of competitors or prey have been reported in the literature. Case studies dealing with the prevalence of trophic cascades have produced conflicting results and many theories about the mechanisms limiting these effects across differing freshwater ecosystems. Current theory cites nutrient loading rates, lake depth, and the presence of omnivores, which weaken links in the food web, as the primary factors limiting cascading responses. These hypotheses have not yet been rigorously tested across a range of lake types and this limits our ability to predict the likely effects of predator stocking in specific ecosystems.

Many lakes across the country and in Illinois receive routine stockings of predatory sport fish to supplement natural reproduction or to create new recreational opportunities. For example, many lakes receive supplemental stockings of largemouth bass to augment natural populations and muskellunge introductions to create trophy fishing opportunities. The number of lakes in Illinois stocked with muskellunge has risen from 8 to 34 since 1988, showing the increasing trend of introducing this predator species. By improving our understanding of the effects of stocking these popular sport fish species and their interactions with aquatic communities, we will enhance our ability to make sound management decisions and understand the possible consequences of such introductions. This is particularly important when stocking waters with established fisheries where ecological effects of stocking may cause economic harm to local fish communities.

*Methods*. We are examining the aquatic communities of multiple lakes in response to supplemental stocking of largemouth bass and muskellunge introductions. Response variables of size structure and abundance of several fish species, zooplankton composition and density, benthic macroinvertebrate density, chlorophyll abundance, total phosphorus, and water clarity are being measured across a series of stocked and control lakes before and after fish stocking to allow comparisons among systems. These lakes have been further divided into two groups based on the planktivorous fish community to examine differences in response between lakes with omnivorous (gizzard shad) and facultative planktivores (bluegill). Examining the effects of sport fish stocking across lakes of varying depths, planktivore communities, and nutrient status will provide powerful tests of current theory on the prevalence of trophic cascades and community response in freshwater systems.

*Preliminary Results*. Responses to predator stocking appear to differ across planktivore and predator species. Supplemental stocking of largemouth bass appears to cause partial cascading responses in lakes dominated by bluegill sunfish (a facultative planktivore) but not in lakes dominated by an omnivorous planktivore/detritivore—the gizzard shad. In bluegill-dominated lakes these responses include increases in large-bodied zooplankton density and a decline in planktivore abundance. Muskellunge introductions thus far have only been examined in gizzard shad-dominated systems and do not appear to influence the abundance of this prolific planktivore. Muskellunge do, however, appear to cause a shift in the size structure of gizzard shad, possibly by increasing predation on smaller size classes.

*Researcher Corey DeBoom measures a stocked muskellunge on Lake Mingo near Danville, Illinois.*

*Next Step*. We are currently examining the variation in responses to largemouth bass stocking within bluegill-dominated systems to investigate other factors that may be influencing the magnitude of community response in these lakes. In addition, we are compiling data from 6 reservoirs that have received new introductions of muskellunge in the past 10 years to further investigate the possible effects of introducing this new predator type on existing aquatic communities and fisheries.

*Corey S. DeBoom and David H. Wahl, Division of Ecology and Conservation Sciences*

# Soil Impoverishment and Prairie Plant Growth

Illinois, the "Prairie State," once had approximately 22 million acres of prairie. Today 99.99% of the original prairie has been destroyed as the result of agriculture and urban development. This means that we have less than 2,500 acres of high-quality prairie remaining in Illinois. Most of this prairie can be found in small, isolated remnants in nature preserves, pioneer cemeteries, and along highway and railroad right of ways.

Prairie reconstruction provides a means to increase this habitat in Illinois. Most prairie reconstruction across the Midwest has occurred in former agricultural lands and Illinois is not an exception. Unfortunately these agricultural lands are very high in nitrogen, which encourages weed growth. The combination of high levels of nitrogen and weeds has hindered prairie reconstruction since the weeds can out-compete the prairie plants. Part of the reason is that prairie plants evolved in soil where available soil nitrogen was limited. However, one particular technique known as soil impoverishment could be the answerer to this problem.

Soil impoverishment is the use of organic matter (i.e., carbon), such as sugar or sawdust in the soil, to immobilize plant-available nitrogen. The organic matter stimulates soil microbe activity and the soil microbes accumulate soil nitrogen in their biomass, making it unavailable to plants. Several studies have demonstrated that carbon soil amendments can reduce soil nitrogen levels during initial plant succession and reduce the number and biomass of weedy species.

Even though carbon soil amendments have been shown to be beneficial in reducing weeds, few studies have been conducted to determine if the reduction of nitrogen in the soil will have an effect on the growth (e.g., plant height, biomass) and reproduction (e.g., fruit and seed set) of prairie plants. For this reason we conducted a study to determine how five carbon soil amendments (i.e., sawdust and sugar, straw, soybean hulls, leaf mold, and brewery waste products) affect: 1) the growth and reproductive potential of a prairie plant species; 2) the nitrogen (nitrates and ammonia) levels in the soil; and 3) the establishment of native and non-native plant species.

*Study plots at the Midewin National Tallgrass Prairie, before and after the five carbon soil amendments were added.* Photos courtesy of H.J. Mlynarski, University of Illinois

We conducted this study at the Midewin National Tallgrass Prairie (MNTP, Will County, Illinois). The MNTP is one of the largest prairie reconstruction projects east of the Mississippi River and the bulk of the reconstructions at this site will be in former agricultural lands. Also, we decided to use *Rudbeckia hirta* L (black-eyed Susan, Asteraceae) as our focal prairie species because it is a common prairie plant and can be purchased at local nurseries. To conduct this study, 60 plots, half with *R. hirta* and half without, were assigned randomly to one of the five soil amendment treatments (i.e., sawdust and sugar, straw, soybean hulls, leaf mold, and brewery waste products) and a control (i.e., no soil amendment). Soil samples were collected before and after the soil amendment treatments were established to determine the levels of nitrogen in the soil. In addition, species richness and vegetation cover were determined for each plot. In the case of *Rudbeckia hirta* information on plant height, number of flower heads, and aboveground biomass was collected. Our preliminary results show that the sawdust and sugar soil amendment is reducing *Rudbeckia hirta* growth, vegetation cover, and nitrogen levels. Additional data analyses are needed to have a better picture of how each carbon soil amendment treatment compares to the others. These preliminary results suggest that adding organic matter in the soil could facilitate the reduction of the emergence of nitrogen-loving (i.e., nitrophilic) weeds in a former agricultural field, but it may also have a short-term negative impact on the growth of prairie plants.

*Brenda Molano-Flores, Division of Biodiversity and Ecological Entomology and Helen J. Mlynarski, University of Illinois*

# Vegetation Structure and Composition of Arabuko-Sokoke Forest, Kenya

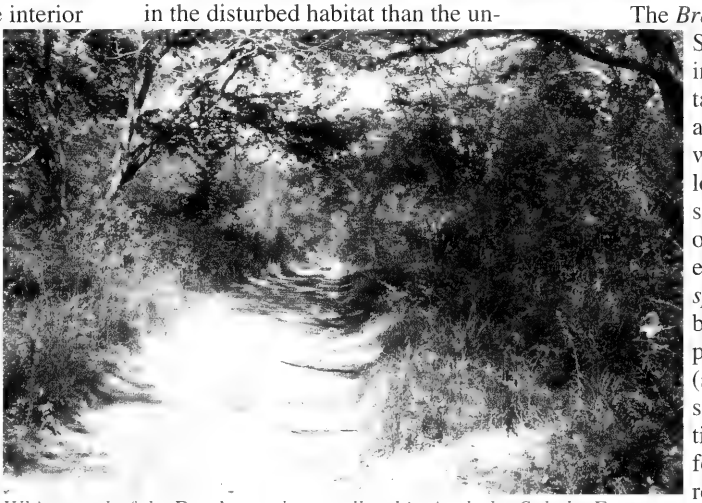
Arabuko-Sokoke Forest, a beautiful remnant of a once extensive coastal forest along Kenya's east coast, is a tremendous repository of biological diversity. At just under 42,000 ha (103,740 acres), this forested tract contains 50 species of globally or nationally rare plant species, at least four endemic butterfly species, three globally threatened mammal species, and six globally threatened bird species, as well as many reptile and invertebrate species. Notable animals include the golden-rumped elephant shrew and Ader's duiker; Clark's Weaver and Amani Sunbird; Bunty's dwarf toad and ornate tree frog.

The heart of the forest is *Brachystegia* woodland, growing on a band of white, infertile sand running through the interior of the forest. The *Brachystegia* forest type is rare and of high conservation priority. We investigated the composition and structure of disturbed and relatively undisturbed patches of *Brachystegia* woodland within the Arabuko-Sokoke Forest. The differences in disturbance level come from past legal and currently illegal logging activities.

*Brachystegia spiciformis*, the canopy dominant, is a graceful, fascinating tree. At Arabuko-Sokoke Forest, it attains a great height and breadth. The trunk generally begins branching close to the ground, and the multiple, curving trunks spread widely with increased height, often attaining heights and spreads of 24 m (79 feet) or more. This leguminous tree has small, pinnately compound leaves that intercept little light. The regularly spaced trees thus allow a patchy, but well-developed understory of shrubs, saplings, forbs, and grasses.

In 2003, we had the opportunity to conduct a quantitative investigation of the Arabuko-Sokoke Forest, allowing us to compare processes known to affect forest regeneration in Illinois with this unique and rare forest type in eastern Africa. We were interested in how past disturbances, like logging and fuelwood removal, affected the forest. Logging in the disturbed forest presumably removes large trees. Thus we expected mean diameter-at-breast height (dbh) to be higher in the undisturbed forest. Furthermore, species experiencing successful regeneration in the disturbed forest should have size distributions more skewed towards saplings and smaller trees than the same species within the undisturbed forest. Unsuccessfully regenerating species should either be unusually rare or lack smaller size classes of trees.

We found seven relatively abundant tree species in the undisturbed habitat, but only six of these in the disturbed habitat. Overall, tree species diversity was greater in the undisturbed than the disturbed habitats. The importance value, a composite index that combines the relative density, frequency of occurrence, and dominance of each species, was greater for *Brachystegia spiciformis* in the disturbed habitat than the undisturbed. *Brachystegia* appears less attractive to wood cutters than other tree species



*White sand of the* Brachystegia *woodland in Arabuko-Sokoke Forest, Kenya.* Photo courtesy of Joseph O. Oyugi, Wright College

By examining the size-class distribution of a species' trees between the disturbed and undisturbed habitats, we can answer two questions: 1) which tree species are regenerating and 2) to what extent does disturbance influence recruitment? For slowly growing species, recruitment is interpreted as vibrant when the tree species has many more small than large trees, but recruitment is considered poor when there are more large than small trees. On this basis, we can suggest which tree species may be regenerating successfully in the two habitats and anticipate future trends in the forest.

Only *B. spiciformis* differed in size-class distributions between the undisturbed habitat and disturbed habitat. In the undisturbed habitat, adults were more abundant than juveniles, but in the disturbed habitat, juveniles exceeded adults. This suggests a mature canopy of trees in the intact forest with suppressed seedling establishment and/or sapling survivorship. *B. spiciformis* may depend upon light gaps for regeneration. Support for this perspective comes from the disturbed forest, where the past removal of canopy trees may be leading to many small and possibly recruiting *B. spiciformis*. The few yet extremely large *B. spiciformis* that we found in the disturbed habitat may have achieved unusual size through the removal of canopy competitors.

The *Brachystegia* portion of Arabuko-Sokoke Forest, though small in area, represents an important example of what may be a northern variant of Miombo woodland. Past selective logging has left an indelible signature through the removal of rarer species, leaving the forest unusually dominated by *B. spiciformis*. The disturbed site bears this out through its preponderance of unusually large (spared trees) and unusually small *B. spiciformis* (regeneration) relative to the undisturbed forest. Four tree species exhibit reduced abundance in the disturbed habitat, but two of them are recovering there. *J. magnistipulata* has been completely depleted from the disturbed habitat, but remains abundant in the undisturbed habitat. Thus active management and restoration may be desirable for this species. For the remaining common tree species, active management may not be necessary. Continued protection promises to maintain this remnant forest, thus assuring its importance as one of the biological treasures of Africa's east coast.

*Joseph O. Oyugi, Wright College; Christopher J. Whelan, Division of Biodiversity and Ecological Entomology; Joel S. Brown, University of Illinois at Chicago*

*Species Spotlight*

# Prothonotary Warbler

Susan Post

*A Prothonotary Warbler perches near its nesting cavity.* Photo by Michael Jeffords, INHS Office of the Chief

If I owned a paint store one of the colors I would offer would be prothonotary yellow. It is the color of the male Prothonotary Warbler's head. It is the same color as the first dandelions of spring—orange-yellow centers that grade to bright yellow. This color lets you know spring is here and brightens the wet woods where the warbler occurs. One ornithologist eloquently described the bird as "an animate mote of golden sunlight moving through dark swamps."

The Prothonotary Warbler, *Protonotaria citrea*, breeds across much of the eastern United States. From April to August in Illinois it is commonly found in the swamps of southern Illinois. By late September the warblers have migrated to the mangrove forests of Central and South America.

Prothonotary Warblers are heavy-bodied and short tailed. They are approximately 14 cm (5.5 inches) long and weigh 15 g (about half an ounce). The male's head, neck, and body are a rich saffron or orangey-yellow, while females are bright yellow with no orange hues. Their black bills and eyes stand out against the plain yellowish heads. Bluish wings and tails complete the picture.

Just as the cardinal gets its name from the red worn by Roman Catholic cardinals, the Prothonotary Warbler gets its name from the eighteenth century Louisiana Creoles who thought the bird's plumage resembled the golden robes of the protonoarius (papal clerk), a Catholic Church official who advised the Pope. Its nickname is the golden swamp warbler, for its affinity for swamps and bottomland forests.

Prothonotary Warblers are found in deciduous swamps, backwater sloughs, wet woodlands without a dense understory, and along slowly moving rivers and streams. This attraction to water may be due to a higher number of decaying trees with nest cavities in flooded areas and the added benefit of lower predation by mammals when the nest site is located over water.

These birds are one of two warbler species that nest in cavities, and the availability of suitable nesting cavities is one of the most critical habitat requirements for them. While abandoned Downy Woodpecker holes are common nest sites, a variety of natural cavities are used, and the birds will readily use nest boxes, preferring those with a smaller internal volume than Bluebird boxes. Since 1994, hundreds of milk cartons have been used in a southern Illinois warbler study by the Illinois Natural History Survey.

Males establish territories around one or more suitable nest sites and place moss inside the cavities before the female arrives. The male displays at each cavity and the female selects from among those available. The nest site is almost always over or within 5 m (16.4 feet) of standing water or in a low-lying easily flooded area. While the male initially places moss in potential nest sites, once a site is chosen the female constructs the remainder of the nest. Prothonotary Warblers are one of the few cavity-nesting species that use large amounts of moss in their nesting. The nests are a combination of moss, grass, sedges, and even fishing line.

After finishing the nest, the female lays 4–6 brown-spotted eggs which hatch after 12–14 days of incubation by the female. Primary predators of eggs and nestlings are rat snakes and raccoons. Ten days after hatching the young leave the nest (fledge), but the parents will continue to feed the birds for up to 35 days. While the nest's proximity to water might deter predators, if the water rises and floods the nest, the hatchings will drown. However, fledging birds can swim.

The warbler forages by hopping on branches, stumps, trees, and the ground, looking for a variety of insects and small mollusks. Caterpillars, flies, midges, spiders, and mayflies make up the bulk of their diet during breeding season.

To chase away the winter grays, head to the swamps of southern Illinois (Heron Pond or LaRue Pine Hills) during April and May for a glimpse of this feathered sunshine.

**Answers for animal/home match on following page**

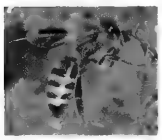
| | | | |
|---|---|---|---|
| 1—g | 5—c | 9—i | 13—f, j |
| 2—d | 6—c | 10—j, e, f | |
| 3—b | 7—k | 11—a | |
| 4—e, f | 8—a | 12—h | |

*The Naturalist's Apprentice*

# Animal Homes Made by Humans

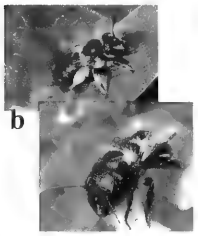
Carolyn Nixon

Many animals, including insects, birds, and mammals, will use homes constructed for them by humans. If nesting places for these species are limited, people can construct artificial nest boxes or platforms. If these are close enough in design to the real thing, the animal may accept it. Conservationists construct nest boxes to help increase reproduction by a species. Many people put nest boxes up around their homes because they like to attract animals. If the animals are beneficial to humans, such as bees who pollinate flowers or Purple Martins who consume large numbers of insects, people construct homes to gain benefits from them. See if you can match the animal on the left with at least one home on the right. Some types of homes can be used by more than one type of animal, and some of the animals may use more than one type of home. Write the letter of matching animals on the blank lines under each image of an animal home.



Honeybees, native to Europe, are kept in man-made hives constructed of stacked wooden boxes or in woven straw or wicker domes called skeps.

**a**



Leaf cutter bees and orchard mason bees lay their eggs in holes in logs. They will nest in logs or blocks of wood with holes drilled in them.

**b**

Purple Martins nest in colonies of multiple compartment nest boxes or hanging gourds on top of a tall pole.

**c**

Bats will roost in wooden boxes that are open at the bottom and mounted high on a building. They will enter through the bottom and cling to the inside walls of the box.

**d**

**e**

Bluebirds will readily build their nests in wooden nest boxes that are placed on poles in open fields. A box with a steeply sloping top is less susceptible to predation by house cats.

House Wrens will build their nests in any kind of nest box, either on a post or hanging from a chain. Smaller hanging boxes with small entrance holes are often provided for them as most other species will not use them.

**f**

**g**

Wood ducks will nest in large wooden nest boxes placed near the water. Wood duck nest boxes have an oval hole, wider than tall.

Toads will rest in toad houses that are often similar to an upside-down flower pot with an entrance hole near the ground.

**h**

**i**

Robins will build their nests on wooden shelves.

**j**

White-footed mice will build their nests in wooden nest boxes that are meant for small birds.

Ospreys will build there nests on platforms on tall poles, usually placed over the water.

**k**

**Image Credits**

- Philip Nixon: honey bee, leaf cutter bee
- USDA photo: mason bee
- Michael Jeffords: toad, American Robin, white-footed mouse, Osprey
- Rhetta Jack: bat
- PGC Photo/Joe Kosack: House Wren, Eastern Bluebird
- Dover Clipart: Purple Martin, Wood Duck
- Carie Nixon: all nest box drawings

**11** _____

**1** _____

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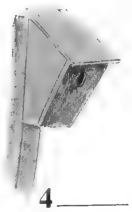

**4** _____

**6** _____

**8** _____

**10** _____

**13** _____

**"The Naturalist's Apprentice" presents educational activities for middle school students. Teachers are invited to photocopy this page for classroom use.**

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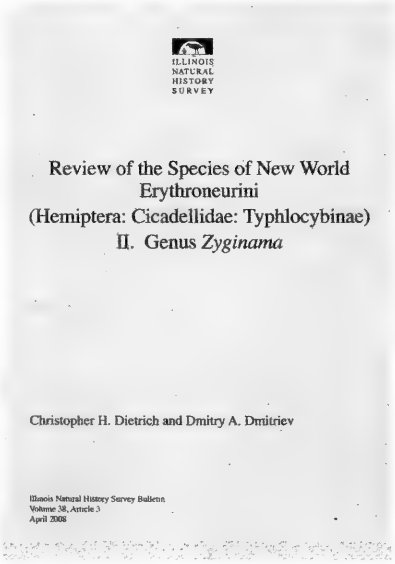


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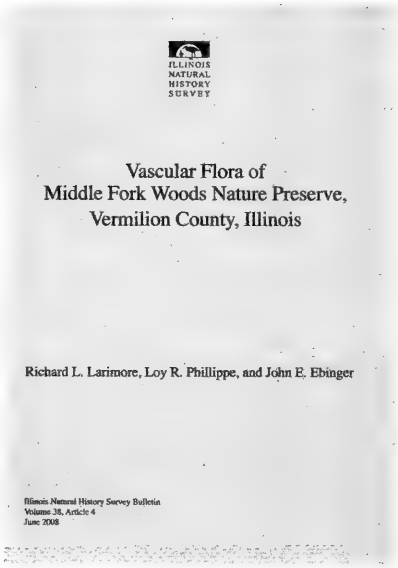


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ILLINOIS NATURAL HISTORY SURVEY
150 years 1858 to 2008
Reports

Autumn 2008
No. 397

INSIDE



# Cat Studies: Wildlife and the Environment

The general public believes that feral cats are outdoor pets, nuisance animals, a threat to native avian species, or an overall source of public and ecological health concern.

All cats are "definitive hosts" (host where the parasite can fulfill its life cycle) for the protozoan parasite *Toxoplasma gondii*. This parasite is known to cause toxoplasmosis, a disease that impacts wildlife, domestic animals, and humans. *T. gondii* can infect humans and wildlife through the consumption of undercooked infected meat, through ingestion of water or soil contaminated with infected cat feces, and occasionally by vertical transmission (mother-offspring). There are often no symptoms of toxoplasmosis in healthy animals but it can induce reproductive failure or death in several species. Encephalitis, blindness, and even death may occur in immunocompromised individuals. On rare occasions, healthy individuals may develop schizophrenia, fevers, weakness, or decreased intelligence. Researchers at the Illinois Natural History Survey Division of Ecology and Conservation Sciences (DECS) are studying feral cat behaviors and the epidemiology of toxoplasmosis to evaluate their influence on native wildlife species and risk for public health. Towards these efforts the following studies are taking place. Some are in initial steps of data analysis others have recently begun.

*Left to right: Nohra Mateus-Pinilla, Shannon Fredebaugh, Nelda Rivera, and Jennifer Rydzewski take samples from an opossum captured at Robert Allerton Park as part of a wildlife disease study.* Photo by Wildlife and Plant Ecology Section staff

*Jeff Horn poses with two cats caught for a radio telemetry study on home ranges.* Photo by Wildlife and Plant Ecology Section staff

Kim Wangen, an undergraduate student in animal sciences at the University of Illinois, worked with Dr. Mateus-Pinilla and graduate students Shannon Fredebaugh, Emily Jewell, and Sangeeta Rao on a scent station and game camera project on cats in the natural areas of Robert Allerton Park (RAP), near Monticello. Beginning in June 2007, 10 scent stations were constructed, each using sand substrate and a fatty acid scent disk lure. They were located throughout the various natural habitats of the park and were regularly checked for mammalian tracks. A digital game camera was rotated throughout each of the sites as a supplement to detect any animals in its vicinity. Foot tracks and photos indicated that cats were present in many of the human populated areas. This study documents frequency of occurrence of feral cat interactions within natural areas in multiple habitats. Follow-up efforts to better understand, document, and measure the impact of feral cats on Quail, Prairie Chicken, Grouse etc. (their eggs and chicks), deserve further research. Additional efforts are underway to document occurrence of *T. gondii* in natural habitats at RAP.

Jeff Horn, a master's student in the Natural Resources and Environmental Sciences Program

*Continued on back page*

# Tracking Vegetation Development in Compensatory Mitigation Wetlands

Federal regulations require that damage caused to wetlands during development activities must be compensated for, often through the construction of replacement wetlands. These compensatory mitigation wetlands are ordinarily monitored for up to five years to determine compliance with a set of legal requirements, usually based on vegetation establishment. Wetland restoration efforts are often unsuccessful, and available data suggest that approximately half of mitigation projects do not meet their specific legal requirements. Comparisons between compensatory wetlands and natural wetlands might help improve the restoration process by aiding the development of scientifically valid predictions of what can realistically be achieved through wetland restoration.

The legacy of wetland loss due to land-use conversion is especially severe in Illinois, and today only about 10% of the state's original wetland acreage remains. It is therefore important that mitigation projects adequately compensate for any additional wetland losses. Illinois Natural History Survey (INHS) wetland scientists have monitored several compensatory wetlands throughout Illinois to determine restoration progress.

In a recent study, I compared the vegetation in 29 of these compensatory wetlands, ranging in age from 4 to 14 years, to vegetation in 553 reference wetlands to determine if the compensatory wetlands are actually replacing the plant communities of natural wetlands. The reference wetlands had been surveyed by INHS scientists and are representative of the natural wetlands that were replaced by the compensatory wetlands. I compared each compensatory wetland to a set of over 50 reference wetlands that were similar to it in latitude and plant community type.

Some desirable attributes, such as the number of native plant species, in compensatory wetlands rapidly exceeded levels in comparable reference wetlands (Fig. 1A). On average, there were more native plant species in three-year-old compensatory wetlands than in 90% of natural wetlands. Many of these species, however, were weedy or annual species that inhabit recently disturbed soil. Therefore, they may not be representative of mature wetland plant communities. The percent of all plant species in a wetland that were perennials increased more slowly over time (Fig. 1B). By age five, the plant species of compensatory wetlands were, on average, 73% perennial, compared to 83% in reference wetlands. Thus, although restored wetlands supported a large number of species, the species were not always equivalent to those in natural wetlands.

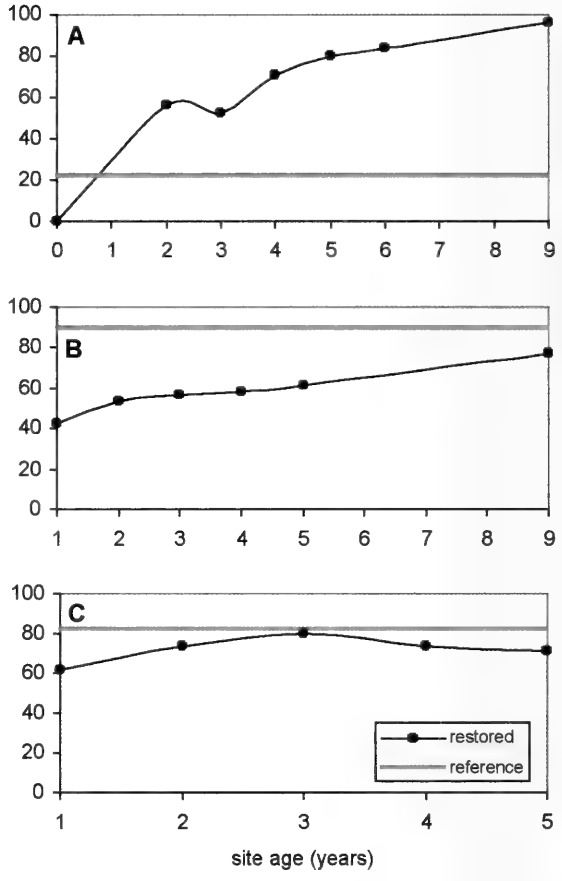
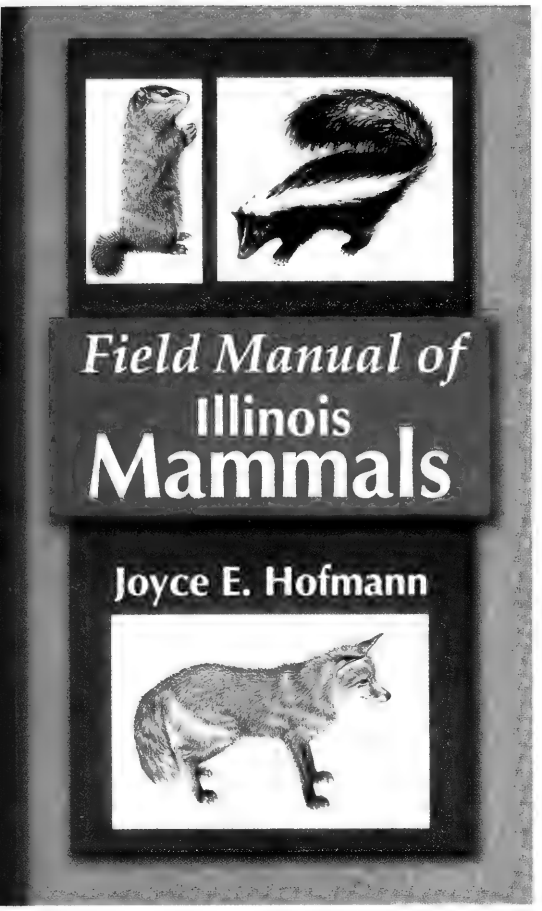



*Figure 1. Vegetation establishment over time in restored wetlands compared to average values among reference wetlands. A. Number of native species in a Sangamon County restored forested wetland. B. Percent perennial species in an Alexander County restored forested wetland. C. Percent native species in a Macon County restored marsh.*

Percent native species often increased initially in compensatory wetlands, but in one-third of the surveyed wetlands it eventually declined (Fig. 1C). Compensatory wetlands in Illinois often became dominated by undesirable, exotic plant species within five years after site construction, indicating that long-term monitoring and more intensive site management may be necessary. Even if a compensatory wetland achieves legal compliance within a five-year monitoring period, regulatory agencies should not assume that it will remain in compliance indefinitely, nor should they assume that the wetland has fully replaced the flora of a destroyed natural wetland.

*Jeffrey W. Matthews, Division of Ecology and Conservation Sciences*

# New INHS Publications

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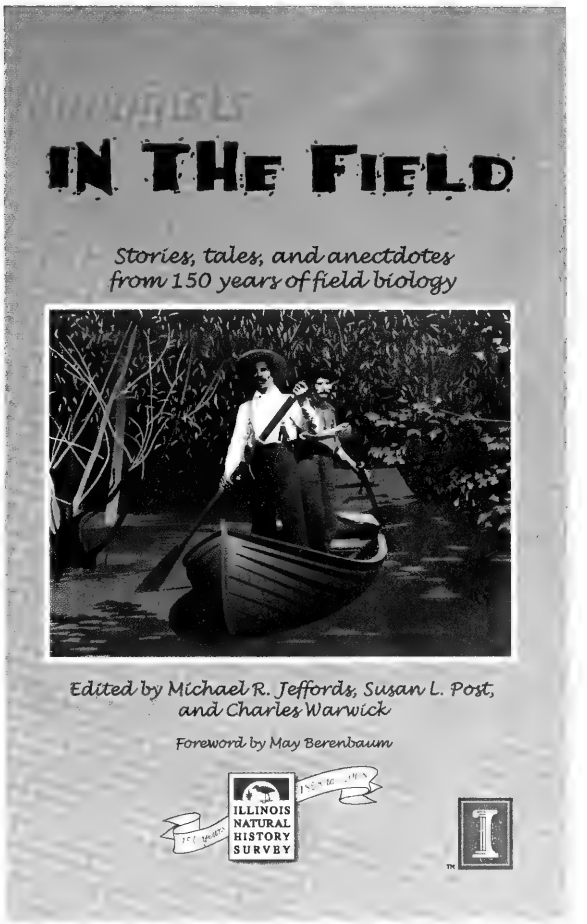


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## ATTENTION READERS

Most of you are aware that the Illinois Natural History Survey was recently transferred from the Illinois Department of Natural Resources to the Institute for Natural Resource Sustainability at the University of Illinois. Even with this move, our focus and core activities shall remain basically what they have been for the past 150 years.

However, due to the current economic conditions as well as a mandate to reduce negative impacts that our activities have on the natural environment, we are actively seeking ways to reduce expenditures and to become more "green" in our day-to-day functions. Among a number of proposed changes, we will begin, as of our Winter 2008 issue, to produce this newsletter solely in electronic form. It will continue to be available at our Web site:

http://www.inhs.uiuc.edu/resources/inhsreports.html.

By going electronic we will save taxpayers about $8,000 per year in mailing and printing costs and, of course, this will indirectly help our environment by eliminating the need for paper and toxic inks.

We are aware that some of our readers may not have easy access to the Internet. Therefore, we will continue to provide these people with paper copies printed from the PDF files of each issue now residing at the newsletter's Web site listed above.

Anyone wishing to receive a paper copy of the *INHS Reports* newsletter must contact us on or before December 15, 2008. Please call, write, or e-mail to:

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We encourage all readers who will be using the newsletter Web site to send us their e-mail addresses (use the address above). When each new issue is placed on the Internet, we will send a mass e-mail, notifying electronic subscribers.

As they have since 1962, *INHS Reports* shall continue to keep our subscribers (and all Illinois citizens) up to date on the most current, state-of-the-art research, which INHS is conducting for the benefit of all the natural communities of Illinois.

With best wishes for a healthy and "green" future,

Charlie Warwick, editor

# Status and Distribution of Pleurocerid Snails in Illinois

Freshwater mollusks are one of the most imperiled groups of animals in North America. At least 210 (70%) of the nearly 300 freshwater mussel species and over 260 (40%) of the estimated 650 freshwater snail species in North America are considered to be extinct, listed as federally threatened or endangered, or are in need of conservation status. The primary factors responsible for their decline are anthropogenic changes to and destruction of their habitat. The decline of freshwater mollusks also is evident in Illinois. Two-thirds (53) of the 80 freshwater mussel species historically known from Illinois are either extinct or extirpated from the state, listed as threatened or endangered, or have declining populations. However, little is known about the status of the state's 76 freshwater snail species.

Freshwater snails are a vital component of many stream ecosystems. Not only does their sensitivity to perturbations allow them to be used as biological indicators of stream health and integrity, but they also occupy a central position in food webs by grazing on periphyton (organisms that grow on underwater surfaces) and by providing a food source for predators. The family Pleuroceridae is a group of gill-breathing, operculate (with opercula or protective plates) snails found in North America, Asia, and perhaps Africa (different malacologists treat African forms as either Thiaridae or Pleuroceridae). Pleurocerids reach their greatest diversity in the rivers and creeks of the southeastern United States.

Within North America, the family Pleuroceridae is composed of 7 genera and approximately 153 species, but this group has experienced a severe decline in diversity in the past century. The entire genus *Gyrotoma* (6 species), which was restricted to the shoals of the Coosa River, Alabama-Georgia and approximately 25 other pleurocerid species are now presumed globally extinct due to inundation of riffle areas by impoundments and habitat degradation from poor land-use practices. These extinct species, plus the five that are on the federal endangered species list, are roughly 20% of the known pleurocerid fauna. However, little is known about the status of pleurocerid snails in Illinois. It has been over 100 years since anyone has addressed the distribution and status of this group in the state. Illinois is on the northwestern edge of the range for 10 species of pleurocerids. Based upon museum records and published accounts, 8 of the 10 species in Illinois are known only from the Wabash/Ohio River basin, whereas the other two occur in the northern two-thirds of the state. Of the eight species exclusive to the Wabash/Ohio River basin in Illinois, one is believed to be extinct and five are believed to be globally vulnerable, which means they are at moderate risk of extinction partially due to restricted ranges and relatively few extant populations.

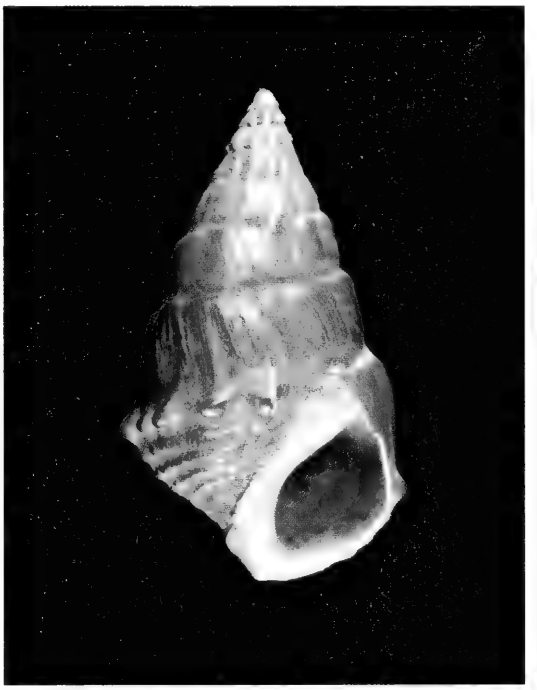


*Photo of* Pleurocera alveare *(Conrad, 1834), the rugged hornsnail.* Photo by Kevin Cummings, INHS

We are investigating the status of pleurocerids of Illinois by visiting museum collections and conducting field surveys. One of the more imperiled groups is the genus *Lithasia*, which comprises three species in Illinois. Our preliminary data suggest that a significant reduction in range has occurred for *Lithasia obovata*, which was historically known from five stream basins in Illinois, but is now only found in a small portion of the Little Wabash River. Although the ranges of the other two species of *Lithasia* do not appear to have undergone significant reductions, their densities appear to have been greatly reduced compared to collections made in the early twentieth century. Potential reasons for the decline are the same as those affecting other freshwater organisms and include siltation, chemical pollution, impoundments, and competition from exotic species.

The dissemination of information concerning the historical and current distribution and status of species is one of the most important functions of a modern natural history museum. Databasing historical information followed by subsequent field surveys will help in formulating a conservation plan to ensure the continued survival of this group. Additional field and museum work will be needed to ascertain the status of the other seven species of pleurocerid snails, some of which may warrant inclusion on the state lists of endangered and threatened species.

*Jeremy S. Tiemann and Kevin S. Cummings, Division of Biodiversity and Ecological Entomology*

# The USDA-NASS Cropland Data Layer for Statewide Annual Land Use/Land Cover Applications

The United States Department of Agriculture, National Agricultural Statistics Service (USDA-NASS) Cropland Data Layer (CDL) Program has been developing crop-specific, geo-referenced data layers for use in geographic information systems (GIS) applications since 1999. The purpose of the CDL is to use satellite imagery on an annual basis to provide supplemental acreage estimates for the state's major commodities. From 1999–2006, the CDL Program used both the Landsat TM and ETM satellites, providing 8-day repeat coverage at 30 meters resolution, but the questionable stability and longevity of the Landsat Program warranted investigation into alternative sensors. Additionally, the reliance on cooperator and NASS Field Office resources for digitizing the NASS June Agriculture Survey was labor intensive and final delivery of the ground truth ran into the late fall. In 2007, NASS implemented a major modernization effort which exclusively uses the ResourceSat-1 AWiFS sensor, as it provides 5-day repeat coverage at 56 meters resolution. The Farm Service Agency Common Land Unit was delivered to NASS during mid-August, providing an abundant set of training fields, while relieving the NASS Field Office staff of digitizing responsibilities. This new protocol provides a much different CDL product, one which characterizes both agricultural and non-agricultural lands, thereby producing an integrated, statewide land-use/land-cover data product. While Illinois' agricultural lands have been assessed for accuracy by NASS as a part of their agency's mandate, the non-agricultural categories were not evaluated—it is only important that NASS account for non-agricultural lands, not assess their relative accuracy. Thus, through a project funded by the Illinois Department of Natural Resources (IDNR), Illinois State Geological Survey (ISGS), and Illinois Natural History Survey (INHS), personnel conducted a formal statistical evaluation of the 2007 Illinois CDL data product, with special emphasis on assessing the accuracy of the non-agricultural lands.

An accuracy assessment was conducted on 11 non-agriculture categories—open water, developed/open space, developed/low intensity, developed/medium intensity, developed/high intensity, barren, deciduous forest, evergreen forest, grassland herbaceous, woody wetlands, and herbaceous wetlands. In order to conduct the accuracy assessment in a short period of time, only counties that contained less than 65% agriculture were included in the assessment. Eight hundred twenty-five ground reference samples were selected in a random sampling approach and stratified by land cover category (Fig. 1). The ground reference points were identified using photo-interpretive techniques, since field verification of these points would be too costly. The cover types for the photo-interpretive reference samples were established using the 1-meter true color 2007 National Agriculture Imagery Program (NAIP) Compressed County Mosaics (CCM) as the base layer. Other ancillary data layers used include the 30-meter Digital Elevation Model (DEM) shaded relief, 100-year floodzones, 2004 color infrared NAIP Digital Orthophoto Quarter Quadrangles (DOQQ's), and the 0.5-meter black and white 2005 National Aerial Photography Program (NAPP) DOQQ's. The overall accuracy of the 2007 Illinois CDL non-agriculture categories is 88.59% with a kappa coefficient of 0.8745. The individual user's accuracy ranged from 77.38% (0.7512) for the grassland herbaceous category to 100.00% (1.000) for evergreen forest. The results of this accuracy assessment show that the NASS-CDL product is sufficient for use by IDNR. Accurate land-use/land-cover data will have multiple benefits for wildlife management and ecosystem planning throughout Illinois. For example, both current planning and management of lands under the IDNR Wildlife Action Plan use the 1999–2000 land cover data, a portion of which is now eight years old. Updated information better describes the current condition of landscape and increases the efficacy of management decisions. Furthermore, because the NASS-CDL data product encompasses the states adjacent to Illinois (except Kentucky), cross-border analyses will be minimized by having consistent land cover categories among states. This will allow, for example, the ability to study the Chronic Wasting Disease outbreak in northern Illinois that includes portions of southern Wisconsin. Finally, because the NASS CDL will be publicly available, it can be used by the wide array of agencies, NGOs, scientists, and individuals involved in the management of Illinois' natural resources. The 2007 NASS-CDL product is currently available for download from the Geospatial Data Gateway (http://datagateway.nrcs.usda.gov/) and will also be available from the ISGS Geospatial Data Clearinghouse (http://www.isgs.uiuc.edu/nsdihome/).

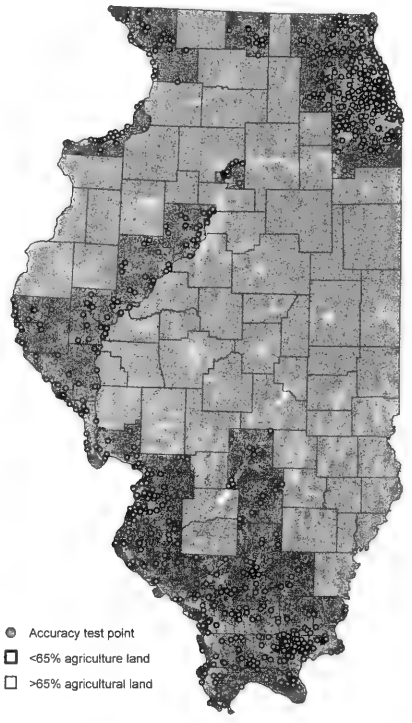



*Figure 1. 2007 Illinois NASS-CDL showing the 40 counties and 825 points used in the accuracy assessment.*

*Tari Tweddale, Division of Ecology and Conservation Sciences*

# Modeling of Stonefly Historical Distributions Using Museum Specimens

Stoneflies are a small group of aquatic insects whose diversity is approximately 3,500 species worldwide (http://plecoptera.speciesfile.org/HomePage.aspx). The nymphs (Fig. 1) are aquatic and the adults are terrestrial. Species are distributed throughout the world, except in areas of perpetual ice cover and in semiarid and desert habitats. North America is home to 670 species (http://plsa.inhs.uiuc.edu/plecoptera/), 77 of which occur, or have occurred, in Illinois (http://www.inhs.uiuc.edu/animals_plants/insect/ILplecoptera.html). They are important in the energy and nutrient economy of streams, providing a link between trophic levels and by returning nutrients back to the land when adults leave the water. Additionally, they are the "Canary in the Coal Mine" of stream habitats, being easily eliminated from a watershed through relatively small losses of forest cover or through moderate agriculture.

Twenty-two species of stoneflies have been extirpated/extinquished from Illinois during the twentieth century, with nearly the same number being critically endangered. Losses occurred in every natural division of Illinois, especially in agricultural areas and medium-to-large rivers of the Wisconsinan till plain.

The Illinois Natural History Survey maintains 22,000 vials/pins of stoneflies, 5,000 records of which constitute the world's best historical and contemporary documentation of a stonefly community for any large geographic area. The authors used 1,800 records of this data set to model the probability of occurrence across the state and to determine what environmental factors are useful for predicting historical distributions. This work is significant because it allows us to more accurately determine their loss from regions of the state and what factors are important for their distribution. Stoneflies may well be a surrogate for the fate of other aquatic species. Additionally, this effort may guide future reintroduction efforts.

*Figure 1. Nymph of the Midwest salmonfly,* Pteronarcys pictetii. Photo by Ed DeWalt, INHS

All records were compressed to 203 unique locations and a species presence/absence data matrix was constructed. Negative records (absences) for a species were derived from the positive records of other species. A second matrix was constructed from local and watershed-scale environmental variables that were not heavily modified by human disturbance. These included climate data, watershed size, natural division affiliation, presettlement vegetation type, slope, glacial form, bedrock and quaternary deposits, stream sinuosity, and several others. These data were subjected to what is called a Random Forests model that provides a probability of occurrence for each species. This model builds many trees (>5,000) based on random subsets of predictors and averages the predictions. It eliminates "over-fitting" common to other modeling techniques and the use of correlated predictors is not problematic.

Four species were modeled fairly well by this procedure. The model was very good at predicting negative occurrences. The two-lined stripetail, *Isoperla bilineata*, had only a 14.6% error rate when predicting for absence. Predicting presence was a bit more difficult, with 53.1% of the cases being predicted incorrectly. This same pattern holds for the other three species. The model found several environmental variables that predicted probability of occurrence for each of the four species. For example, Frison's stonefly, *Acroneuria frisoni*, was found to be an eastern Illinois species, with most populations having occurred in the recently glaciated sections, and was generally confined to the Wabash and Ohio River basins (Fig. 2). These findings are congruent with the historic distribution for Frison's stonefly. As the focus of a reintroduction study, these data are particularly valuable for determining where reintroduction should occur. Recently secured Wildlife Preservation Fund monies will allow for collection of regional, extant populations and genetic analysis to determine which population to use as a recolonization source.

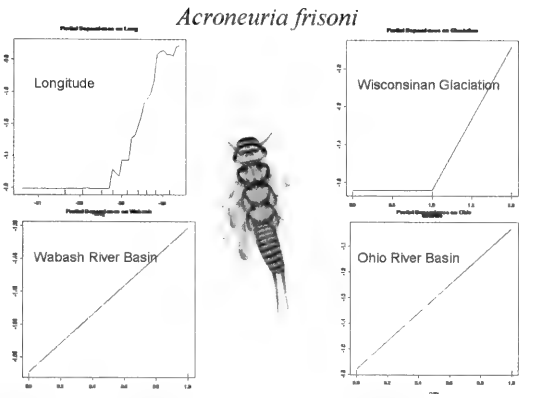



*Figure 2. Predictors for one species of stonefly. Y axis is the log of probabilities, X axis is the value for environmental variables.*

This modeling effort is focused on Illinois, so the results may not be reflective of the species' historical distribution across a wider geographic region. We are amassing historical distribution data from all regional museums in the Midwest. Expansion of the modeling effort to this region may actually improve the model's performance, mainly due to increasing the number of records. Refinement of the model is possible through addition of more environmental variables. In the near future, we hope to provide contour maps of probability of occurrence across the Midwest from southern Ontario and Ohio to the Mississippi River and north through Wisconsin.

*R.E. DeWalt, Division of Biodiversity and Ecological Entomology; Yong Cao, Tari Tweddale, and Leon Hinz. Division of Ecology and Conservation Sciences*

*Species Spotlight*

# Common Green Darner Dragonfly

Susan Post

By late summer the cicada/katydid droning has reached a crescendo and if you venture out during the late afternoon you might be rewarded with gatherings of large dragonflies, dancing, swirling, and dipping above you. Yet this whirlwind of dragonflies seem to always be just out of reach of an entomologist's net. These large dragonflies are the common green darners, *Anax junius*. Their name means "Lord and master of June," even though these insects may be found from early spring to the first weeks of fall.

The green darner, one of the largest dragonflies (2.5 to 3.25 inches long), is found in every state, including Alaska and Hawaii. Both sexes have "bull's-eyes" on top of their foreheads and unmarked, green thoraxes. Mature males have blue abdomens while females' and immature males' abdomens are a rusty brown. Their preferred habitat is any type of slow or still water that is vegetated. Females oviposit their eggs in mats of algae, pieces of rotting wood, in the stems of growing plants at the edge of pond, or in floating vegetation.

Once the eggs hatch, the green darners begin life in the water as dull-colored, predatory larvae, called naiads. These naiads are varying shades of brown and green, which offer camouflage in the mud and debris as they climb about the submerged vegetation of their watery habitat. Naiads will tackle any unfortunate small crustaceans, minnows, tadpoles, or their favorite prey, immature mosquito larvae, that get in their path. To capture their prey the naiads' lower jaws have modified structures, like "folded grappling hooks." This modification is called a labium. It can shoot out in a hundredth of a second, seizing its victim with two grasping hooks at the tips. When not in use, it is folded underneath the head. In addition to the labium, the naiads also use jet propulsion to make sure they can make a fast getaway from predators. By expelling water out the ends of their abdomens, somewhat like hydraulic cannons, they can rocket two to three inches through the water and away from any predator.

After one or more years of aquatic life (depending on food availability), and if the naiads have been able to avoid the attention of fish (their chief predators), they will climb out of the water and metamorphose into adults. A dragonfly specialist quipped that the process of a naiad becoming a flying machine was "somewhat comparable to taking an automobile and transforming it into a small jet airplane." Emergence from the water usually occurs at night. The naiad climbs out of the water onto a stick, plant, or anything that projects out of the water, and attaches itself. It's skin splits down the back and the adult emerges soft and glossy with crumpled wings; this is a dragonfly's most vulnerable stage as it pumps blood into its wings and waits for them to harden.

*The common green darner dragonfly.* Photo by Michael Jeffords, INHS Office of the Chief

Adults support two pairs of rigid, transparent wings, which are held outstretched even at rest, and a long, thick body. They do not fold their wings and a comparison would be if humans had eight-foot 2 by 4s strapped to their hands to help them move about! Dragonflies do not give any outward appearance of grace on the wing, however, they are the best flyers in the insect kingdom, with some species having been clocked at over 35 miles per hour as they fly forward, backward, or sideways. The wings are asynchronous—they operate independently. One-third to one-half their body mass is devoted to flight muscles.

Their eyes are the largest in the insect world and are so big that their heads appear to be all eyes. They have three simple eyes (ocelli) and a single pair of compound eyes that gives them a nearly 360-degree field of vision, resulting in excellent eyesight. They can observe insect prey up to 40 yards away.

Their forward-directed legs are located in a cluster near the front of the thorax and are arranged in a basketlike way to catch prey (prey basket) and quickly transfer it to the mouth. Dragonflies are so well-adapted as airborne predators that their legs are nearly useless for walking.

Names for dragonflies were based on their fierce appearance and the belief of their nasty abilities. The unenlightened once thought dragonflies were capable of sewing shut the mouths of men who cursed and women who scolded or they sewed up the ears of people who enjoyed gossip. From these myths a variety of names sprung up such as—snake doctors, horse stingers, sewing needles, and the Devil's darning needle. The myths and names are in reference to the distinctive shapes of their abdomens and the mistaken belief that dragonflies are capable of inflicting stings and harmful to mankind. The only harm the insects do, however, is to mosquitoes, gnats, and flies, some of their favorite foods; thus earning them the name mosquito hawks.

*The Naturalist's Apprentice*

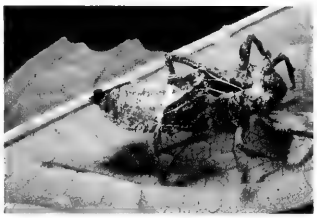
# Observing Dragonflies

Caroline Nixon

Dragonflies are active throughout the daylight hours and are often colorful and easy to observe. When you visit a wetland, pond, or stream, see how many of the following dragonfly behaviors you can observe. Before you begin, write your name, the date, time, and weather conditions (temperature, windy or calm, cloudy or sunny) on your paper. You can create a list of the behaviors and make a check mark for each time that you observe the behavior.

**Emergence**—a dragonfly or damselfly nymph will leave the water and climb up a plant or rock. Its skin will split along the dorsal (back) side of the thorax, and the adult dragonfly will pull itself free. It will then sit as its wings expand and its exoskeleton hardens.

**Cast skin**—the dragonfly will leave the empty skin of the nymph behind. These can be seen clinging to rocks and plants.



cast skin

courtship

**Courtship**—the male dragonfly will cling to the back of the head of the female, using claspers on the end of his abdomen.

**Mating (wheel position)**—the male will attach the end of his abdomen behind the head of the female, and the female will attach the end of her abdomen to the base of the male's thorax.

mating (wheel position)

**Oviposition (egg laying)**—dragonflies lay their eggs in a variety of ways. Some stand at the edge of the water and dip their tail into the mud; others fly over the water, either just the female, or male and female attached together, and the female will dip her tail into the water. Still others will cling to a plant stem in the water and back down it, lowering the end of their abdomens into the water along the stem.

**Patrolling**—dragonflies cruise their territory, often zig-zagging back and forth as they look for prey. When they detect insect prey, they will veer upwards or sideways suddenly, as they pursue and capture their targets.

**Gleaning prey**—they may also hover over vegetation looking for prey on the leaves. If they spot something, they drop quickly to the plant.

**Consuming prey**—if a dragonflies captures a tiny prey item, it may eat it instantly. For larger prey, it may return to a perch to consume it, usually removing the wings and eating it head-first.

damselfly feeding

thermoregulating

**Grooming**—dragonflies must remain perfectly clean and can sometimes be seen grooming by moving their legs across their body, eyes, or wings.

**Thermoregulating**—dragonflies are able to raise or lower their body temperature to some extent. To lower body temperature on a hot day, a dragonfly will point the end of its abdomen up into the air (obelisk position) or it my hold its wings forward and slightly downward. To warm its body on a cool day, it may vibrate its wings while perched.

**Perching**—dragonflies often sit atop plant stems or on a leaves. They may be basking in the sun or surveying their territory.

perching

All photos by Michael Jeffords, INHS

If you see other behaviors that do not seem to fit in one of the categories, describe it on your sheet.

Damselflies, smaller and more dainty relatives of dragonflies, also practice the same behaviors, but are more difficult to observe. You can record the same information for damselflies, as well. If you do record behaviors for both dragonflies and damselflies, be sure to note which you observed. You might want to use separate columns for each group.

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# Cat Studies

*continued from front page*

at the University of Illinois, along with Drs. Mateus-Pinilla, Warner, Heske, and Schooley, conducted a telemetry study on free-ranging domestic cats on the South Farms and adjacent properties at the University of Illinois (UIUC). Starting in January 2007, owned cats were radio-collared after written permission was acquired from owners participating in the study. Live trapping was conducted on university property to capture feral, or unowned, cats starting in May 2007. Unowned cats were anesthetized, fitted with radio collars (break away collars), and then released at the site of capture. A tracking vehicle was used to obtain locations needed for home range and habitat preference estimations. Half of the radio collars were equipped with trip-switches that allow for acquisition of activity data for those cats, which can be downloaded remotely using a receiver. Tracking was completed in June 2008 and live trapping was conducted to recapture the unowned cats to remove the collars and alter them in cooperation with the Champaign County Humane Society. This research is in the initial stages of data analysis and is expected to highlight the importance of studying owned and unowned cats in the same setting. Analysis will be conducted on seasonal home range comparison, habitat use, activity patterns, and survival.

Shannon Fredebaugh, a master's student in the Natural Resources and Environmental Sciences Program at UIUC, working with Drs. Mateus-Pinilla, Richard Warner, and Milton McAllister, is focusing on the occurrence of *T. gondii* in medium-size mammals at Robert Allerton Park as an initial step to document the potential impact (measured as prevalence of *T. gondii* infection) of feral or free-roaming cats on native species and their environment. This summer, this research team trapped over 50 raccoons and 15 opossums among other species. Blood samples were collected an serum samples will be tested for indications of infection with the parasite. Laboratory work will be initiated in the fall and trapping efforts to complete the requirements of the study design will continue into 2009.

*Kim Wangen, Shannon Fredebaugh, an Jeff Horn, University of Illinois; Nohra Mateus-Pinilla, Division of Ecology an Conservation Sciences*